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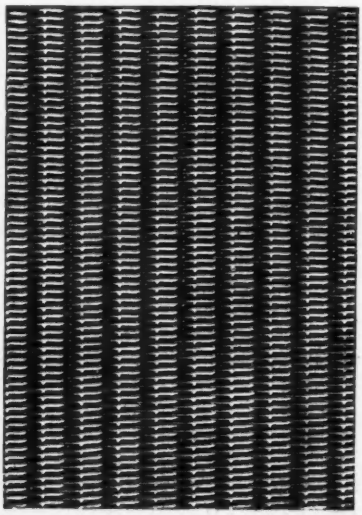

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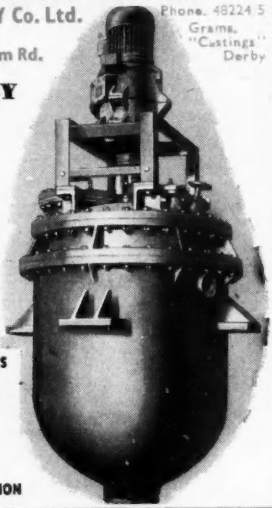

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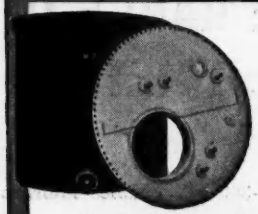

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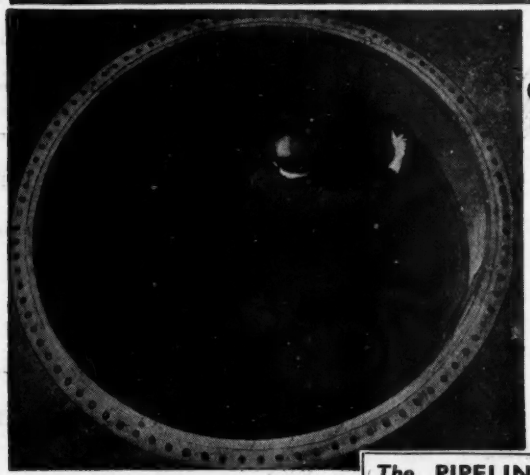

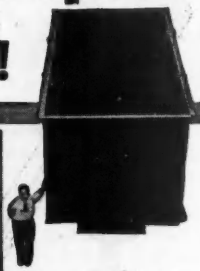

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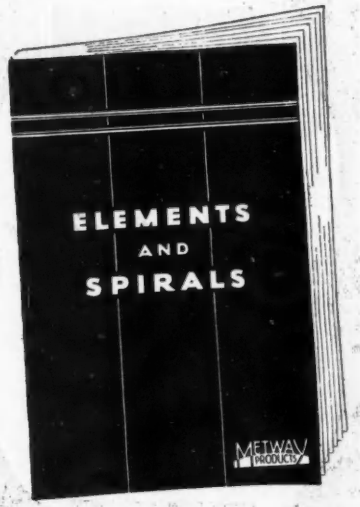

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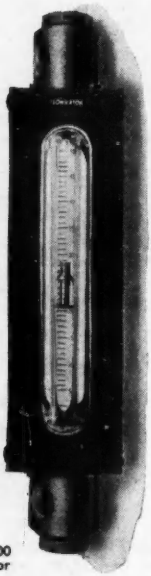

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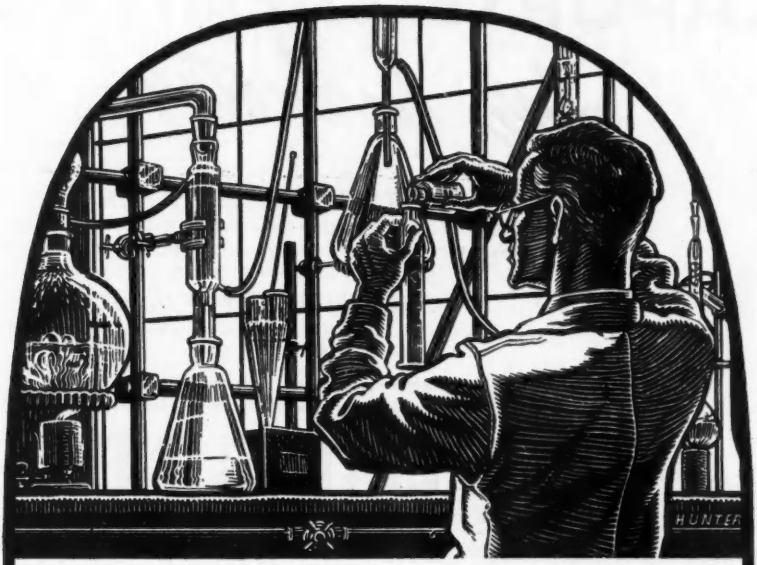

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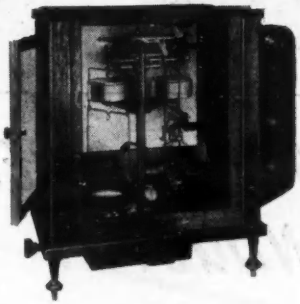

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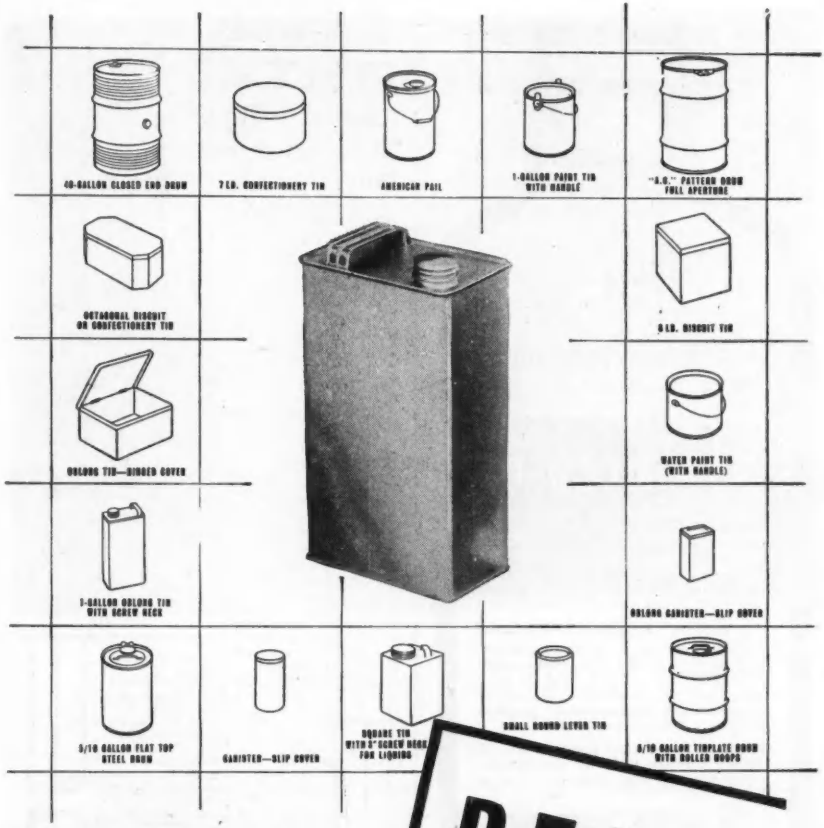
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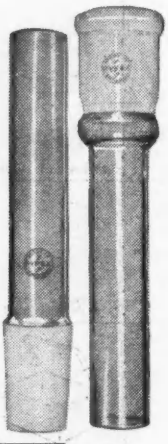

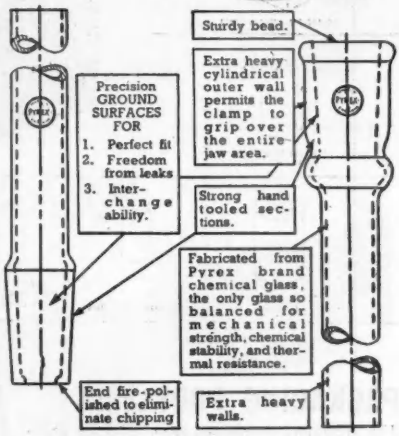
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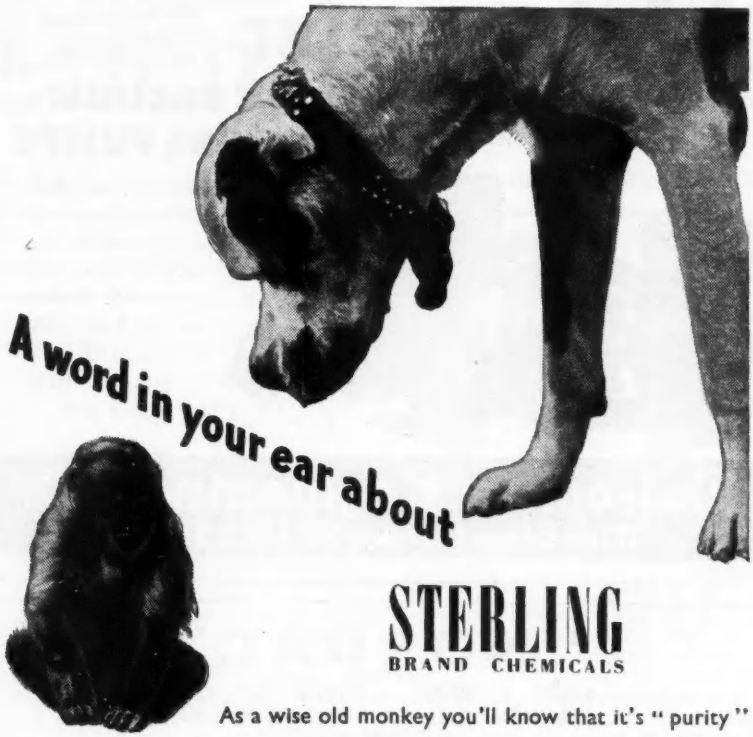

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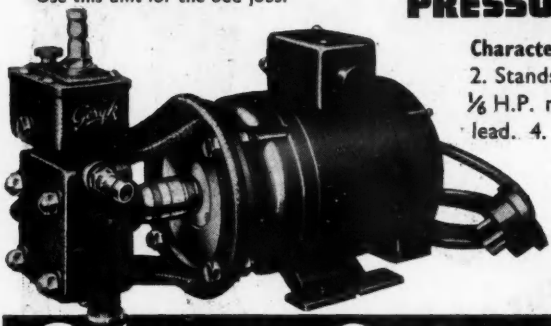

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Volume LXV | 7 July 1951 | Number 1669

Grants for Research

WHEN war broke out grant-aided research associations were spending approximately £480,000 a year, of which £170,000 was contributed by the DSIR. At that period the Government regarded grants as a form of temporary assistance which would be discontinued as soon as associations were able to be self-supporting. This policy was radically changed in 1945, when the Lord President stated that grants to research associations would form a permanent part of the activities of the DSIR. This change was based on a realistic appreciation of the national value of research undertaken by associations organised and financed largely by the industries concerned. In making voluntary contributions to their association member firms are not only benefiting themselves and their industry but are playing an indispensable part in the national programme of research. It is right, therefore, that the Government through the DSIR, should bear its share of the cost of industrial research, particularly in view of the very heavy taxation on profits.

The present system is based essentially on voluntary membership of associations, the Government grants being on a *pro rata* basis designed to provide maximum assistance in the initial stages, since heavy expenditure is liable to be incurred at this period, although during the first years of operation an association may be largely dependent for its financial support on the enthusiasm of a few foundation members. Grants are subject to renewal and readjustment every five years, the new allocation being arrived at after careful examination of the anticipated requirements, taking into consideration current revenue, future prospects, and the magnitude and importance of the programme planned. Present policy is based on the assumption that suitable grants will continue to be made until a research association is self-supporting and until its activities have reached the optimum scale. In 1943 the sum available for grants to research associations was raised from £300,000 to £500,000. It is now £1,500,000. This in itself is an indication of the success achieved by the present system in stimulating the expansion of research. In general, the joint partnership between industry and the State has been both happy and fruitful, due in no small measure to the manner in which the DSIR has been able to co-operate with research associations without the vexations of Government interference.

The present satisfactory relationship is liable to be drastically altered if a

recommendation by the Public Accounts Committee is adopted. In its Third Report for 1951, the Committee have expressed the opinion that *pro rata* grants are not calculated to promote efficient economy, and that they might also result in grants from public funds to research directly benefiting industries well able to meet the cost from their own resources. The Committee 'trust', therefore, that when considering applications for grants by industrial research associations, the Department will obtain sufficient information as to the financial position of the industries concerned, 'in order to make sure that they make payments only in cases of proved necessity, and that in assessing the amount they will have greater regard to the capacity of an industry to pay for its own research.'

At first sight these contentions have an air of reasonableness which is highly misleading, but the implications are extremely dangerous. In effect, research associations would be subjected to a means test and would have to come cap in hand to the State to beg for grants. On what basis is 'ability to pay' to be assessed? Presumably on the profits of an industry as a whole. It follows that research associations might be deprived of grants if—as sometimes happens—a few large firms in their industry persisted in withholding their support. Particularly serious would be the effects on young associations whose members were confined to a relatively small proportion of the industries concerned. The only alternatives would be either limitation or abandonment of research projects, or the substitution of compulsory levies for voluntary contributions, thus destroying a priceless asset of research—enthusiasm.

A still more serious consequence would be the inquisition into the affairs of an industry which would necessarily precede the sanctioning of a grant based on 'ability to pay'. There is a very real danger that this might cause widespread resentment, and that despite all efforts by State officials to avoid the appearance of Gestapo methods, the DSIR might be cast for the role of inquisitor instead of friend. It is hard to find any justification in fact for the contention that *pro rata* grants fail to promote economy, since the sliding scale system ensures that the sums allocated are directly related to the needs of particular industries at a given time. Moreover, adequate machinery exists for safeguarding the taxpayer against the misuse of public funds for superfluous or excessive grants.

The existing system is admirably fulfilling the Government's policy of providing an incentive to the expansion of industrial research. On the other hand, it would be hard to find a more certain means of discouraging research than the introduction of a 'means test' for associations, with all the undesirable accompaniments of this form of aid.

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Notes & Comments

Rhenium Developments

RHENIUM, first discovered in Germany in 1925, is one of the neglected metallic elements, but recent research in America at the University of Tennessee suggests that it may have important specialised uses. Rhenium is a heavy metal with a melting point as high as that of tungsten but experiments have shown that it has a longer life than tungsten at any operating temperature. It would seem to possess, therefore, interesting possibilities as a component of high-temperature alloys. It also has a higher electron emission than tungsten and for this reason would be useful in the manufacture of high vacuum electronic apparatus. Before the war some commercial supplies of rhenium were produced in Norway, but post-war production has not apparently been revived. Experimental quantities are being made in the United States from flue dusts derived in the processing of molybdenum sulphide, itself a by-product from copper sulphide ore. The rhenium in the flue dust is converted into potassium per-rhenate, which is then reduced to the metallic element by hydrogen. The metal thus produced is in a dark grey powdery form though it is normally described in the literature as a silver-white metal. The costs of small-quantity production would appear to be very high, for the powder is selling at more than £300 a pound. However, if development research establishes a demand for the metal, it is believed that better and larger sources of rhenium than by-product flue dust can be found and also that cheaper methods of extraction and reduction can be worked out.

Crystals versus Corrosion

A NEW approach to protection against rust and corrosion during storage and transport is entirely chemical though the name or formulation of the chemical substance used has not yet been revealed. Briefly, crystals of this substance are placed with the metallic objects to be protected; a vapour is steadily released and this forms a thin protective film on the metal surfaces. The name or term given to the substance is 'volatile corrosion inhibitor' and it is a product of the Shell organisation in the U.S. It is claimed that the vapour reaches even the most inaccessible parts, and completely surrounds them with the anti-corrosion film. The practical method of using the substance is to coat a paper or other wrapping with the powdery crystals. It is necessary for the object to be completely wrapped with the treated paper and, of course, for this wrapping to be sealed. If further tests are successful, it is possible that the volatile corrosion inhibitor may displace grease coatings for metallic equipment. Though such greases can be easily applied, they cannot give protection to inaccessible parts and considerable labour cost is involved in subsequently removing the grease coatings when the equipment is taken out of store for use.

Alloying Metals Shortage

FOLLOWING hard on the much publicised shortage of sulphur, in fact accompanying it, has been the shortage of the essential rare metals used for alloying, to help overcome which was part of the purpose of Mr. Stokes' visit to Washington recently. It is therefore very gratifying to learn that America, besides helping us with our supplies of sulphur, is also prepared to safeguard our supplies of molybdenum, a metal largely concentrated in the United States and of vital importance to the manufacture of such key materials as bearings, resistant steels, and machine tools. This metal, if only it were plentiful enough, might well replace tungsten, as it did during the war. Tungsten is another of the current scarcities. Lack of supplies from China and Korea has enhanced this shortage and as Burma continues to export very little, due to internal disorders, the main demand for the metal falls on Portugal. Nickel, of course, is the most important of the alloying metals, and at the moment is probably the most critical. Unfortunately it looks like remaining so

for some considerable time to come, since Canada is the only main producer, and although she is expanding production, the demand so far outstrips the supply that there is little hope of the metal becoming abundant for some time. Columbium (niobium) is in the same position to-day as tungsten was when its properties were first discovered—in growing demand— for it has been found to prevent 'weld decay' in nickel steels and to stand up to the stresses of jet engine construction in these steels. Nigeria is the main producer here. Chrome ore is also short, due more to transportation and shipping difficulties than to mine resources, and the manganese supply is centred in Russia, India, South Africa and the Gold Coast. Cobalt, a much smaller commodity than manganese, is vital in steels used in jet aircraft and high-speed cutting machines, as well as in tungsten carbide tips and magnets. Here the world is largely dependent on the Belgian Congo and Canada, although Northern Rhodesia's output is rising; for all that, the metal is scarce. Lastly, boron, obtained from borax, which is the only one of these elements in relatively plentiful supply, has emerged as quite a promising alloy material. The figures of consumption and supply for these essential minor constituents of many different alloys make it clear that sulphur is not the only raw material in short supply. Modern industry, coupled with rearmament, has placed a strain on the supply of important metals that will mean a lot of ingenuity and economy in their use if serious shortages are to be avoided. This is no new thing in industry to-day and, unfortunately, is likely to continue for some years to come. The need at the moment is for boosted mine output and judicious sharing of the materials available.

F.O.B. *Industrial Information*

CLOAKED by the slightly misleading title of 'Design Review' is a remarkable combined information service and catalogue of the Festival of Britain. Housed in seven arches under Waterloo Bridge, it is the most up-to-date illustrated record in existence of British achievement in industry. Chemical plant and instruments, including laboratory ware are well represented in the section. 'Design Review' is intended primarily for visitors with special interests, such as industrial executives and trade buyers who will be able to examine photographs and information sheets at their leisure. In specially-designed index cabinets are housed photographs, or sometimes samples, with full information and descriptive matter mounted in transparent holders. Each index card lists the full description and salient design parts such as constructional details, materials used and mechanism as well as the manufacturer's name and address. A space provided for quoting price exclusive of purchase tax has usually coyly been left vacant by most manufacturers. A rather poor selection of periodicals is also available. On call are interpreters, fluent in all the principal languages, who are able to assist foreign visitors in this unique and valuable reference organisation.

Improvements Invited

WHILE the basic character of this unit is fixed, its detailed arrangements are still continuing to evolve. Acting on a visitor's suggestion, they are now compiling a list of factories which may be visited—a list which already includes many chemical, food and drink manufacturers. Both the main catalogue and the list of factories remain open to receive fresh additions. The organisers are emphatic that manufacturers should note that they can continue to submit items for 'Design Review' although the Festival has opened. The whole idea of laying out the 1951 stock list in this bright, easy-reference form, staffed by courteous and well-informed assistants is highly to be commended. This should form the nucleus of a permanent organisation to guide both internal and external inquirers to the most useful suppliers, attractively supplementing the normal reference library facilities of rows of stodgy catalogues.

Open-Day at Colworth House

Unilever Food Research Centre Attracts Interest

A LARGE party of industrial, university and Government scientists, as well as leading industrialists and the editors of a number of trade and technical newspapers, accepted the invitation of the chairman and board of directors of Lever Brothers & Unilever, Ltd., to a luncheon at the new Unilever Food Research Centre at Colworth House, Sharnbrook, Bedfordshire, on Wednesday, 27 June. Following the luncheon, at which visitors were welcomed by Sir Geoffrey Heyworth (the chairman), the laboratories and horticultural and farming activities were inspected.

A special train carried the party from London to Sharnbrook and a fleet of coaches was available for taking visitors to and from the station and for conducting them around the 1,200 acre estate. The reception and luncheon were held in a huge marquee which had been erected on the lawns outside the house.

Fourth Research Centre

Welcoming the company's guests, Sir Geoffrey said that Colworth was the fourth research centre to be established by Lever Brothers & Unilever, the other three being at Port Sunlight, in Holland and in America. It was still in its infancy (he said) and when it was fully developed it would employ about 100 graduate scientists and would be approximately the same size as the other three. Broadly speaking its field would cover research in food, the technology of food, animal nutrition and horticulture. It was hoped that in time it would help Britain bridge the gap between the demand for and the supply of food.

'Make Yourself Necessary'

To achieve its purpose it needed the help of both the local and central governments and he was glad to say that they had already had considerable assistance from both. He hoped that they would also receive help from all those present.

In conclusion Sir Geoffrey said that they hoped they would be able to live up to the motto they had found on Colworth House when they arrived.—'Make Yourself Necessary.'

Professor Sir Frank Engledow, Professor of Agriculture at Cambridge University, replied on behalf of the guests.

Splitting up into groups the party was conducted around the centre which consists of Colworth House, the Development Division, the estate and the farms.

In the House the visitors inspected the

Colworth House

chemical, physical and bacteriological laboratories and the library.

These are of the very latest design, are well-equipped and are supplied with electricity, calor gas, steam, high- and low-pressure water and air pressure. At present the graduate staff consists of 50 scientists and there are 90 assistants but it is hoped that eventually 300 will be employed, including 100 graduates.

It would not be fair to describe the work now taking place in the laboratories but the problems being investigated are those connected with the firm's interests in the canning and deep-freezing of fruit and vegetables, the processing of meat, the curing and deep-freezing of fish, and the production of a variety of processed foods such as ice-cream and tomato purée. Research in the detergency, margarine and edible oil and in the oil milling fields is being carried on in the Research Department at Port Sunlight while the research in food and animal nutrition is being done at Sharnbrook.

Production Conditions

Leaving the laboratories the visitors inspected the experimental processing and development section and field plots where trials are under way designed to improve the quality of the final product and reduce their overall cost by such means as the exploration of new and more suitable varieties, methods of increasing yields and the extension of the length of the frosting season. The fruit and vegetables used in these trials must be given the treatment which they would receive in production conditions and so they must be processed immediately after gathering and stored under deep refrigeration conditions so that later on they may be tasted to determine their quality on storage. Similarly, the development of new food processes, which begin by laboratory investigation, must be continued by the design and erection of pilot plant which will be the precursor of production equipment. It is small wonder, therefore, that the importance of the processing and development section was stressed by the guides.

The next port of call was the small animal houses where some 30,000 pedigree white rats will be bred per year. The foundation stock had been transferred from Port Sunlight and is so highly bred that the pedigree of any particular litter can be traced back hundreds of generations. They will be principally used for carrying out biological checks on the results of chemical experiments. Much of the work is in the vitamin field although tests for digestibility are also important.

On leaving the small animal houses the various parties were taken by coach around the farms, visiting the poultry and cow-houses and the piggeries. Some sixty head of cattle and some 200 pigs were housed in the most modern type of farm building and it was explained that these departments were far from being completed.

On the completion of the tour the guests were entertained to tea in the marquee before the gathering left for the station and London.

The concept of a single centre of research in such diverse fields as the chemistry and technology of foods, animal nutrition and horticulture, appears at first sight so wide as to hazard the success of the undertaking. As the company points out in the attractive brochure it has issued describing the centre, this will not be the case as their endeavours will be concerned to a lesser extent with the search for fundamental knowledge, and more to the fields of applied research directed to meet the immediate and future needs of its different food industries. In this they will differ in their approach from university departments and research institutes working in similar and allied fields. Colworth is an integrated food research unit in which many of the different activities are so closely interdependent that they will act as catalysts to each other's success.

While Lever Brothers and Unilever will naturally make full use of the achievements of their new research team, the nation as a whole will also benefit as much of the information obtained will be shared with other scientists through the medium of the scientific and trade Press. The growth of the centre, will, therefore, be watched with considerable interest by all those interested in food and nutrition.

Ordnance Factory Explosion

Six men were killed in an explosion which occurred at the Royal Ordnance Factory at Puriton, Somerset, on Friday, 28 June. The explosion apparently occurred in a chemical plant in an isolated area. A formal court of inquiry opened on 2 July. The sole survivor, Mr. Roy Hardurge, is expected to give evidence later.

PARLIAMENTARY TOPICS

Eighteen Sulphuric Acid Plants for Britain

Ministry of Materials & Shortage Problems

RESPONSIBILITIES of the Ministry of Materials were discussed in the House of Commons on 27 June when the Lord Privy Seal, Mr. R. Stokes, introducing the second reading of the Bill, explained what he termed 'the object of the exercise.'

As had already been set out in the White Paper the new Ministry will take over responsibility for basic raw materials of the chemical industry, including salt, bromide, calcium carbide, glycerine, molasses, phosphate rock, potash salts, mercury, arsenic, iodine, bismuth, sulphur, sulphur-bearing materials, sulphuric acid and fertilisers.

The chemical industry generally 'the products of which are in the main produced by complex manufacturing processes' will remain under the Board of Trade.

As far as practicable, said Mr. Stokes, the intention was that all raw material questions should be dealt with in one place instead of in several, but more particularly that a responsible Minister, with time at his disposal, undistracted, should focus attention on raw materials supplies and be free to watch both short and long-term supply requirements.

One of the main items to come under the control of the Minister of Materials was sulphur, sulphuric acid and fertilisers. These had not been separated because they were so intermixed that it would be impossible to divide them up.

Eighteen New Plants

Eighteen new plants or conversions for the production of sulphuric acid by means of pyrites and the anhydrite process were also planned or already under construction. The first plant is expected to be operating in July this year.

The effect of this would be that by 1954 the total of sulphuric acid produced in this country would have risen from 280,000 tons to 900,000 tons*, and the effect on the raw sulphur position would be that our imports would be reduced by 50 per cent by 1955-6, which was a very considerable step.

Materials for ferrous alloys, such as ores and concentrates, would come under the new Ministry, but not iron and steel production. After consultation with the non-ferrous and light metal trades it had been decided that semi-fabricated material should remain with the Ministry of Supply, metals only being taken over by his department. The Non-Ferrous Metals Directorate at Rugby would come to his Ministry in its entirety.

Procuring metals necessary for the manufacture of ferrous alloys, such as ores and concentrates—and even soot for vanadium—would be his responsibility, continued the Lord Privy Seal. The obtaining of iron ore, scrap and other steel-making raw materials remained with the Ministry of Supply working through the Iron and Steel Corporation. In international negotiation, however, such matters would come under his direction.

Iron and Steel Corporation

He was not taking over the Iron and Steel Corporation as the Government had come to the conclusion that it would not be advisable at the moment to make any alteration in the working of the Corporation with the Ministry of Supply.

An important part of the work of his Ministry would obviously be both the conservation of material and the development of other resources and of alternative methods. He would naturally co-operate with the Natural Resources (Technical) Committee and the Department of Scientific and Industrial Research, where, he thought, a tremendous amount could be done.

Maximum use would be made of the practical knowledge of those two bodies. The examination of alternatives was, of course, a long-term project, involving, in many cases, considerable capital outlay. That was specially so—and those who know about ores could bear him out—as regards ores particularly from overseas, which were becoming more and more difficult to get and lay deeper and deeper.

Alternative methods and uses were very much bothering those who had to make use of such things as lead and zinc. It had always seemed to him absolutely absurd that

* *For comment, see pages 11 and 12.*

so much zinc should be wasted on galvanising*. When people realised that lead and zinc were likely to be in permanent short supply, the sooner alternative methods were found the better it would be for all.

According to statisticians, at the present rate of consumption there was only 14 years' proved supply of zinc, so the quicker technicians and people who understood these chemical processes got on with the job of finding alternatives the better.

It would be his responsibility, continued Mr. Stokes, to see that there was economy in the use of all these materials while, at the same time, it would continue to be the individual responsibility of the Production Department to use their best endeavours to see that there was no waste or abuse by the consumers. He would look after both home and overseas development so far as they affected materials under his Department, and would give help where necessary.

Real appreciation of our problem existed in Washington, added Mr. Stokes.

American Assurances

It was the considered opinion that no very great decisions could be expected from the International Materials Conference until the committees had all reported back to their own Governments. Therefore, the effective operation of the committees could not be expected to appear until towards the fourth quarter of this year.

His American friends had assured him that they would do everything regardless of how these committees functioned to see that we were kept in sufficient supply.

The Sulphur Committee had made giant strides and was almost on the point of final conclusions. A final decision had not yet been reached on the third quarter's allocation, but he believed we would receive enough to meet our essential requirements.

Provisional allocations of tungsten and molybdenum for the third quarter had been put before the Governments concerned for approval.

Although these allocations might not be as much as we could wish, the important thing was to see that at any rate some provisional supplies were obtained so as to ensure that the flow of materials was not interrupted.

A vitally important point was to increase the production of raw materials within the Commonwealth. The Government had, therefore, recently proposed to other Commonwealth Governments that a meeting should be held later this year between representatives of Commonwealth Governments to consider problems connected with the production and supply of raw materials and manufactured goods. The Colonial Empire would also be represented.

In conclusion, the Lord Privy Seal said that this problem of raw material shortages was not only a short-term matter. Although the short-term was vital, there was a more important and wider aspect.

There was no cure for the Communist menace by force. There was, he said, no such way out, although we might deter it for the time being. The long-term cure was the steady improvement in the standard of living of the masses of the people everywhere. That surely meant better use, better availability and better distribution of raw materials.

Quoting a letter from *The Times* of 21 December, 1940, Mr. Stokes said:—

'The resources of the earth should be used as God's gifts to the whole human race, and used with due consideration for the needs of the present and future generations.'

Ultimately, that plan would have to be carried through to its finality if we were to procure peace for all time, by the development of our manufacturing capacity to bring up the standard of living of the people everywhere, so that peace might prevail.

New Finance Bill Clauses

On 28 June the House of Commons dealt on the Report Stage with a number of new clauses to the Finance Bill.

The first of these was the new clause to extend the drawback on duties on hydrocarbon oils to cases where the oil was not an actual physical ingredient of export goods but was used as a material, solvent, preservative or finish in the manufacturing process.

The new clause gives the Treasury power to determine, trade by trade, cases in which the drawback should be paid, and the basis on which it should be calculated.

This was accepted by the Opposition as better than nothing, although Mr. Geoffrey Lloyd expressed regret that the Government had not been able, as many other industrial countries had done, to give a general exemption from tax on all light oils used for industrial purposes.

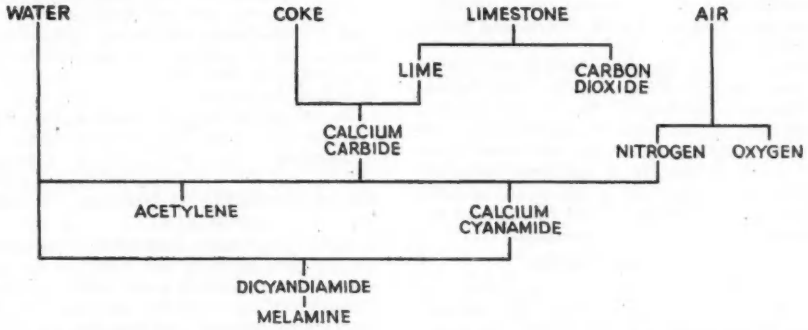
* *For reaction of Imperial Smelting Corporation, see pages 11 and 12.*

Industrial Uses of Oxygen

Developments in the Manufacture of Melamine

NEW developments in the production of medium purity oxygen and the manufacture of melamine were recently referred to by Mr. J. S. Hutchinson, chairman of the British Oxygen Company, at its annual general meeting.

While medium purity oxygen can readily be recognised as an extension of the company's business, the connection between melamine and its present interests may be better appreciated by the following chart:—



Basic interest of the company, as implied by its name, is the production of oxygen.

Apart from a small but important use in medicine, oxygen is used in industry for a wide variety of purposes. The principal industrial uses have been for attaining very high temperatures and of the possible fuel gases acetylene provides the highest flame temperature. An extensive business in manufacturing and distributing bottled acetylene, and also in providing equipment for the use of the oxy-acetylene flame for a range of purposes has been developed.

Despite efforts in various parts of the world to develop an economic and convenient process for manufacturing acetylene from hydrocarbons, the method generally in use today is the reaction between calcium carbide and water. This has led the British Oxygen Company to take an interest in carbide manufacture, which is carried out by an associated company, Odda Smelteverk in Norway.

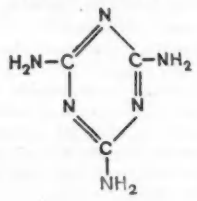
Nitrogen separated from the air along with oxygen reacts readily with calcium carbide to provide the fertiliser, calcium cyanamide. This is one of the two commercially successful methods of fixation of nitrogen and is, of course, an established process. Calcium cyanamide, however, is not only an excellent fertiliser but also a potential source of organic nitrogen compounds. On hydrolysis it theoretically yields cyanamide by the reaction:

$$CaCN_2 + 2H_2O \rightarrow H_2N.CN + Ca(OH)_2$$

In practice, however, the dimer, dicyandiamide, is more stable. The actual structure of this white crystalline solid is not known with certainty, but is probably

$$H_2N-\overset{\overset{NH}{\|}}{C}-NH-CN$$

While dicyandiamide is itself a useful substance as a chemical intermediate and might be used as a raw material for the plastics industry, it is normally converted to melamine, or triaminotriazine:



The chemical mechanism by which three molecules of dicyandiamide are transformed to two of melamine has not yet been elucidated. The main outlet for the melamine is its sales to firms in the plastics industry to react with formaldehyde for a variety of uses.

These melamine-formaldehyde resins are thermo-setting resins which are of particular value because of their water-resistance and their electrical properties. They find their outlet in plastic mouldings, laminated sheets, adhesives, paints, textile and paper. treatment.

In the past the principal uses of oxygen have been to obtain higher temperatures than are possible by the use of air in a variety of reactions. Some of these uses require high purity oxygen. In recent years, however, a number of industrial processes have been suggested in which considerable quantities of oxygen would be required but where high purity is not essential.

Tonnage Oxygen

Oxygen, of 85-98 per cent purity is referred to in this country as 'medium purity' oxygen. The term 'tonnage' oxygen is used in America because it is considered that very large quantities of oxygen of this purity might be needed.

Technical and economic aspects of medium purity oxygen have been studied by the British Oxygen Company for a number of years, and it is quite clear that the joint requirements of lower purity and larger scale of operation enable new technical methods to be employed and a lower cost of manufacture to be achieved. There are a number of possible basic cycles which can be adopted, of which the company prefers its own patented Rescol process.

Uses to which medium purity oxygen may be put include iron and steel manufacture. other metallurgical processes, the complete gasification of coal and various chemical methods. The company has been in close touch with developments in these various fields and is ready to provide supplies of for any new development.

It is, however, important to realise that the use of oxygen in large quantities generally means considerable changes in plant layout, operating methods and labour arrangements, so that the potential user of medium purity oxygen is involved not only in experimental work but also in considerable capital outlay.

New Italian Oil Refinery

In Full Operation by 1952

FURTHER details of the progress on Condor's 1,300,000 tons per annum refinery at Rho, near Milan, were given at the annual general meeting of Condor S.p.A. per l'Industria Petrolifera e Chimica, held on 23 April. The refinery is connected with the central port of Genoa by a 72-mile pipe-line with a 12-in. diameter. Purchase of materials for this pipe line and for the associated tank farm at Fegino (Genoa), is almost complete. Construction is in progress and it is expected that the refinery will be in full operation by the end of 1952.

It was stated at the meeting that the collaboration with Petrocarbon, Ltd., of Manchester, which acts as consultant to Condor and which is responsible for a large part of the design and planning, continued to be entirely satisfactory.

It has previously been announced that the Condor refinery will comprise (a) an atmospheric distillation plant with a working capacity of 30,000 barrels of crude oil per day; (b) a catalytic cracking plant with a capacity of 15,000 barrels per day; (c) recovery, separation and purification plants for the liquid and permanent gases produced by the distillation and cracking plants; and (d) refining plants for liquid gas, gasoline, kerosene and white spirit, together with a blending plant for the addition of tetraethyl lead to the gasoline.

High Octane Products

The whole range of petroleum products will thus be made available to Italy and Central Europe. Of particular importance are high octane number gasolines and liquid gases (C4's and C3's) for domestic and industrial use. Storage tank capacity amounts to 82,000,000 gallons and exceptional facilities will be provided for the efficient filling of products into road and rail tank cars.

A special deep-water dock is being constructed in the central part of Genoa. Here the largest ocean-going tankers can berth and their cargoes of crude oil will then be pumped to the refinery by pipe-line, *via* the intermediate storage tanks at Fegino (2½ miles from the dock).

To carry out this constructional programme, the company has in the past year increased its capital from Lira 300,000,000 to Lira 3,000,000,000.

Zinc Industry's Progress Outlined

Imperial Smelting at Bristol Fair

ON the occasion of the Bristol Industries Fair held from 25 June to 6 July at Bristol, the Imperial Smelting Corporation Ltd., of Avonmouth, exhibited a stand showing a schematic working diagram of a zinc production plant. Also there were a contact sulphuric acid plant in diagrammatic form, and descriptions of the recovery of anhydrous hydrofluoric acid—another product of the company. The diagrams showed clearly by means of lights and moving parts the passage of zinc concentrates through the various stages of roasting, sintering, briquetting, coking, and distilling, in the only vertical retort process in the country—the others in the world comprise three in America and one in Germany. The company's zinc activities cover the production of not only pure zinc, but also of the metal in other formulations such as dust, alloys, lithopone and zinc oxide, processed at works at Bloxwich, Avonmouth, Luton, Widnes and Burry Port. Cadmium, the important trace element in zinc, is also recovered at Avonmouth and purified.

In a speech at the luncheon given at the company's stand on 29 June, the director and general manager of the company, Dr. Walter G. Hiscock, surveyed progress in the zinc industry since its inception. During the first World War, he said, the zinc industry was very much a 'Cinderella industry' flourishing during the war but being neglected afterwards. Its importance now, however, was undisputed, and the Imperial Smelting Corporation was now responsible for a number of factories stretched across England.

Struggle for Supplies

Stressing the struggle that is now necessary to obtain enough zinc, Dr. Hiscock said that even the supply of zinc concentrates from Broken Hill in Australia was no longer enough to fulfil the mounting demand for zinc from defence and industry. The Imperial Smelting Corporation, said Dr. Hiscock, supplied 3 per cent of the country's zinc requirements, and 12 per cent of their acid requirements, and he was surprised to see Mr. Stokes say in the Commons recently that the consumption of sulphuric acid in this country has gone up from 280,000 tons in 1942 to 900,000 tons* at the present time. The I.S.C. make 220,000 tons a year themselves, and, asserted Dr. Hiscock, 1,800,000 tons of acid were used last year in the country and an estimated 2,100,000 tons will be used in 1955, making the figures quoted in the House quite incomprehensible. Dr. Hiscock criticised the new Minister for saying in the House that galvanising was a waste of zinc*, since this was the most efficient and the best means of protecting steel there was, and he suggested that the Minister was badly advised.

No Encouragement

Dr. Hiscock also said that although they had actually increased their output of sulphuric acid recently, this had been done without a shred of encouragement from the Government, who controlled the price of acid and of sulphur, and had had no foresight in guarding against the present shortages of sulphur. The Imperial Smelting Corporation, said Dr. Hiscock, had, four years ago, converted two plants to spent oxide, and when, one year ago, the shortage of sulphur looked like becoming worse, they had installed burners for producing acid which it was hoped to have in operation by the middle of 1952.

Drawing attention to the excellence of the labour in the south-west of England, Dr. Hiscock urged the migration of some of Britain's industry to the south-west, especially as the sulphuric acid supplies of the south-west exceeded local demand at the moment and had to be transported many miles to the north of England, Scotland and London. 95 per cent of the workpeople were in incentive schemes at Avonmouth, said Dr. Hiscock, and he defied anyone to get more work out of anybody.

The harmony between employers and workpeople was demonstrated by the good reception of training schemes, by lectures requested out of working hours and by the enthusiastic participation in games of all kinds by the staff. A new venture—a magazine covering the activities of the I.S.C. and

* *See pages 7 and 8.*

all its associated companies and subsidiaries—had been requested by the group, and the first edition, handed round during the luncheon, most attractively printed and laid out, contained a number of highly interesting and well-written articles.

Replying to a question, Dr. Hiscock said that the research department was a good one, most of their activities covering the uses of zinc, the recovery of cadmium, and the manufacture and uses of sulphuric acid. In the old days, he said, the company used practically to give away the sulphuric acid that it produced, but now they were planning to use more of it themselves in the new field of fluorine chemistry, principally in the production of anhydrous hydrofluoric acid. The industry, he stated, was the first one to supply that commodity for use in the atomic energy programme.

In an interview later, Dr. Hiscock deplored the lack of enterprise in some industries where fluorine products were concerned. Development of some of the more revolutionary products using fluorine was, he said, handicapped by a lack of interest in these outstanding new advances and an unwillingness to find any new applications for them. It was this, he said, which had been the major factor in limiting the Imperial Smelting Corporation's activities in the fluorine field to the production of anhydrous hydrofluoric acid.

O.C.C.A. Reorganisation

FROM 1 July, the Oil and Colour Chemists' Association has established its own offices on a permanent basis. The membership of the Association has increased rapidly and the *Journal* has so increased in size that the Council felt that it was no longer fair to keep so much of the work of organisation on the shoulders of the honorary officers.

Consequently, a general secretary has been appointed, both to look after the general affairs of the Association and to deal with the editorial side of the *Journal*. In future, all business inquiries and communications should be addressed to the general secretary, Mr. R. H. Hamblin, M.A., at the new offices, Memorial Hall, Farringdon Street, London, E.C.4.

The 1951 Conference of the Association was held at Scarborough from 29 May to 2 June, and the technical side took the form of a symposium on pigment/vehicle relationships. The Conference was attended by nearly 300 members and guests, and at the annual general meeting held during the Conference, the following Honorary Officers were appointed for the current year: president, Mr. L. O. Kekwick; hon. secretary, Mr. R. S. Law; hon. treasurer, Mr. N. A. Bennett; hon. editor of the *Journal*, Dr. R. F. Bowles.

To Study U.K. Fire Prevention

FIRE prevention experts from nine European countries arrived in London on 27 June on a two-week visit to the United Kingdom. Their visit will form the first part of a European tour sponsored by the Organisation for European Economic Co-operation under Technical Assistance arrangements.

British members of the team are:—

Mr. S. H. Clarke—Director of Fire Research, Department of Scientific and Industrial Research and Fire Offices Committee, Joint Fire Research Organisation; Mr. A. E. Bowles—H.M. Inspector of Fire Services, Home Office; Mr. W. H. Tuckey, O.B.E.—Director of Fire Offices Committee, Fire Protection Association; Mr. P. V. Rutledge—president, Fire Extinguisher Trades Association; Mr. J. Wallace—Fire Research Organisation, DSIR and FOC (Secretary to the team).

Arrangements for the visit have been made by the Department for Scientific and Industrial Research. The mission will study recent research by British scientists into fire prevention. It will also visit the Fire Service College at Dorking, and rural and urban fire stations to see the latest methods employed by firemen, such as the use of wireless in mobile cars.

The visitors will hear about the fire protection advice given to the public, and will see a demonstration of modern fire extinguishing appliances. At an R.A.F. Station they will be told of the work of Air Ministry experts in preventing and controlling fires caused by air crashes.

After leaving England the team will continue its European tour by visiting France, the Netherlands, Western Germany, Switzerland and Italy. On their return, members will prepare a report which will be circulated in OEEC countries.

New Simon Research & Development Buildings Opened

THE Simon Engineering Group's new research and development buildings were formally opened on 3 July by Sir Henry Tizard, G.C.B., A.F.C., F.R.S., chairman of the Advisory Council on Scientific Policy, at a luncheon to over 300 guests representing the senior levels of the industrial and scientific world and of various Government departments.

Proposing the toast of 'The Guests', Lord Simon of Wythenshawe said:—

'We realised towards the end of the war that it was our national duty to increase our exports to the utmost, and that if we were to go on competing successfully with the world's foremost industrial nations we must tackle research and development on a new scale. That is one of the main reasons why we have spent a quarter of a million pounds on the new buildings and equipment which you will see this afternoon.

'In the last five or six years we have achieved about £25 millions of exports to something like 40 countries in most parts of the world, including the United States and Canada. Our present order book of over £50 million includes a large coke oven battery in America, a £2 million contract for coal preparation plant in Turkey, a £2 million grain elevator contract for the Argentine Government, and power station contracts in Australia and the Middle East for about £6 million.

Heavy Home Programme

'We also have a heavy programme at home in building power stations for the British Electricity Authority, coal cleaning plants for the National Coal Board, coke ovens for new steelworks like Margam and Shotton, and many sulphuric acid plants. In connection with the sulphuric acid shortage, Simon-Carves have been appointed main contractors for the United Sulphuric Acid Corporation's £3½-million project for plant at Widnes to produce sulphuric acid from anhydrite, and they are acting in the same way for the I.C.I.'s £1½-million anhydrite scheme at Billingham.

'Our home and export markets depend on each other. Neither by itself can support our organisation at the size we have now achieved, a size which is essential if we are to undertake research and development on the scale needed to sell our brains and experience in world markets. Our export efforts demand first-rate technical know-how; that in turn demands not only the enlarged scientific staff and resources with which we have equipped ourselves but also a good home market, in which we can build plants which are immediately accessible for operational study.

Home Market Essential

'This leads me to a point of vital importance, which I should like to emphasise in the presence of distinguished representatives of our nationalised industries. Great concerns like the National Coal Board and the British Electricity Authority may clearly be tempted to design and build their own plants. I hope they will not take this step, which would deprive us of much of the home market which is such an essential foundation for our export business. I hope that by continuing to place their orders with engineering contractors like ourselves and allowing us to co-operate with them to the full they will give practical aid to British engineering exports, which are valuable enough to deserve encouragement.'

In reply, Sir Henry Tizard said that it was wrong to say that only the big firms could afford to do research. No firm could afford to do without research. He challenged anyone to name a firm who had ever started research and then given it up.

A research department could be too big. It could be an advantage to have a small but active research division but one learned what was best through experience. In America they had decided that they were overdoing it and he felt they were right.

There was, he said, a stage when no progress could be made by the research worker without recourse to industry. One of the main objects of research was to increase the productivity of labour and this meant practical applications. The gross inequality of standards of labour in different countries was a danger to peace and research could help erase this. The results of our research must be passed on to less fortunate peoples.

In the applications of science he felt there was room for improvement. Although he could not see a time when the present products of the Simon Group would not be needed he hoped that new possibilities would be watched, checked and developed in their new laboratories.

New British Sulphur Plant

Fawley Project to be Completed by 1953

WORK on a major plant for the manufacture of sulphur is to be begun soon at Fawley, near Southampton. Production capacity is estimated at about 12,000 tons of 95 per cent chemically pure rock sulphur a year, and completion is expected early in 1953.

This project, which will help considerably towards reduction of the present gap in sulphur supplies, forms the third stage of construction at the refinery, now being built by the Esso Petroleum Co., Ltd., at Fawley, which will eventually have an annual output of over six million tons of petroleum products. The first two stages comprise the building of the main refinery units for the production of fuels and lubricants.

The new refinery has been designed to extract from crude oil the maximum quantity of sulphur economically available in the refining operation and, at the same time, to use as little sulphur as possible in its various treating processes. In these processes no sulphuric acid whatsoever will be used and for a refinery of such size and complexity using crude oil from the Middle East, Fawley may well have the lowest sulphur requirements of any in the world.

Sulphur, which is released in the refining of the crude oil, will be converted in the new plant by means of a controlled oxidation process.

This method is particularly interesting because it actually turns a disadvantage into an advantage, for Middle East crude is characterised by a higher sulphur content than crude oil from other parts of the world and a proportion of this sulphur has in any case to be removed.

As a consequence of the foresight which has been exercised in planning the refinery, these factors have been turned to good account and the company has been able to respond quickly to the Government's urgent call for an increase in sulphur supply.

De La Rue Exhibition

WHEN the Great Exhibition was held in Hyde Park in 1851, Thomas De La Rue & Co., Ltd., had already been established in London for more than 30 years. Now, with the Festival of Britain on, the company is holding its own exhibition. This opened on 2 July and will remain open until 19 July at 26 Conduit Street, London, W.1.

Although it is not of particular interest to chemists it is well worth a visit for anyone who has an hour or so to spare—particularly to those who have an interest in stamps, foreign currency, playing cards, etc. Several museum pieces, including a banknote printed by the company for Mauritius in 1864 and the original plates used to produce the first stamps printed by the company by the direct-plate process in 1879 are on show.

In the chemical field Thomas De La Rue & Co. are well-known as plastics manufacturers and an interesting section of the exhibition is devoted to displays showing the manufacture and uses of Formica, Traffolyte, Delaron and extruded plastics.

To Absorb Appreciation

The Board of Trade recently announced increased fertiliser prices, to operate from 1 July, due largely to final withdrawal of the subsidy.

Under an Order now made by the Treasury, a *stock charge* is to be made on stocks of fertilisers and fertiliser materials held by manufacturers at the time of the price increases. This will correspond to the subsidy element in the exceptional profits which will accrue to manufacturers when the increases take effect. The object of this charge is to withdraw profits from manufacturers to the extent that their fertilisers and fertiliser materials have been acquired at prices subsidised from public funds.

The Treasury Order also imposes a *production charge* on home production of phosphatic fertilisers—basic slag, superphosphates, triple superphosphates, and fertilisers containing phosphoric acid (P_2O_5) in the form of ammonium phosphate—so that these and imports necessary to supplement them can be sold at the same price.

Seventieth Anniversary of the S.C.I.

Meeting in London Next Week

SINCE its inauguration in 1881 the annual meetings of the Society of Chemical Industry have been held in various parts of the British Isles, each of which has contributed its own character to the proceedings.

But it is only fitting that the 70th anniversary, which coincides with the Festival of Britain, should be held in London—the heart of the British Commonwealth. The S.C.I. will welcome its visitors from home and overseas to the series of meetings which begins on the evening of Monday next with a reception at the Geological and Science Museums.

Week's Programme

A full and interesting programme for the week's festivities was outlined by Mr. H. W. Cremer, C.B.E., chairman of the *Chemistry and Industry* sub-committee of the publications committee of the S.C.I., at a reception given to the Press at the Dorchester Hotel, London, on 2 July.

Describing briefly the growth of the society, Mr. Cremer said that it was founded in 1881 and granted a Royal Charter in 1907, and now had a membership of about 8,000. There were in all 19 geographical sections including American, Canadian, Australian and Overseas.

Chemical industry, he said, had expanded more than any other during recent years and with it the Society's various subject groups had also developed, and continued to expand to meet modern trends or needs as necessary. There were now nine subject groups, the oldest being that devoted to chemical engineering. The remaining groups were: Food, Agriculture, Plastics and Polymer, Fine Chemicals, Road and Building Materials, Corrosion, Microbiology, and Oils and Fats.

'Water in Industry' is the theme of a series of 12 lectures to be given at the Royal Institution, Albemarle Street, W.1, and the Royal College of Science, South Kensington.

Among the notable speakers in this series will be Professor H. S. Taylor of Princeton University, who will read a paper on 'Heavy Water as a Tool in Scientific Research.'

Special interest attaches to the talk to be given by Dr. M. A. H. Tincker on 'Hydroponics—the Growth of Crops Without Soil.' Another matter of increasing importance to industry is that of water pollution. 'Disposal of Industrial Waste Waters' in the U.S.A. and Great Britain is to be discussed in two papers.

Dr. F. W. Mohlman of the Sanitary Laboratory, District of Chicago, will present the American aspect and Dr. B. A. Southgate recent developments in Britain.

Paying a tribute to the retiring president, Mr. Stanley Robson, who has been responsible for many metallurgical processes for the extraction of zinc, Mr. Cremer said that he was one of the leading British experts on the manufacture of sulphuric acid and had erected acid plants in many countries.

The president-elect for 1952 was Mr. John Rogers, chairman of Imperial Chemical Industries, Ltd., and a member of the Society since 1899. He was one of the pioneers of the modern British chemical industry.

The medal of the Society of Chemical Industry is awarded not more often than once every two years for conspicuous services to applied chemistry. The award need not be made to a member, and there is no restriction on nationality.

Professor Dodds Honoured

Presentation this year will be made on 11 July to Professor E. C. Dodds, M.V.O., F.R.S., D.Sc., Ph.D., M.D., F.R.C.P., F.R.I.C., F.R.S.E., Courtauld Professor of Biochemistry at the University of London, and director of the Courtauld Institute of Biochemistry at the Middlesex Hospital, London. He is noted for his synthesis, with Sir Robert Robinson and others, of stilboestrol in 1938, and his work on the preparation of insulin.

The subject of Professor Dodd's medal address will be 'The Decisive Influence of the Chemical Industry on Medicine.'

An excellently produced handbook has been prepared for members which besides setting out clearly the programme of lectures, meetings, and some 36 visits which can be made during the week, also gives a map of central London, showing the principal places of interest and buildings connected with the meetings.

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Metallurgical Section

Analytical Chemistry of the Less Common Alkali Metals: Part I—Lithium

LIKE the other alkali metals, lithium forms relatively few insoluble salts, but some of its more common salts are markedly less soluble than those of the other alkalis, and have been used to detect the metal in admixture with other members of the group. The more common salts of lithium which are insoluble are the carbonate, fluoride and phosphate.

Sodium carbonate does not precipitate small amounts of lithium at ordinary temperatures, but the carbonate is much less soluble in hot water, and the test is best carried out by adding sodium carbonate to the boiling solution[1]. Ammonium carbonate should not be used as precipitant, as it is found that the presence of ammonium salts inhibits precipitation. The interference due to other ions which also precipitate with carbonate, can be overcome by using excess of the reagent on the cold solution, and subsequently boiling the filtrate. In this way the interference of the alkaline earths can be readily overcome.

Under the microscope the lithium carbonate crystals are found to resemble gypsum, being hexagonal stars or plates. The limit of detection is 10^{-4}. Ten-fold excess of sodium and potassium slightly diminish the sensitivity, the former more than the latter.

Phosphate Precipitation

A slightly more sensitive test for lithium is provided by precipitation of the insoluble phosphate. The precipitant most generally used is sodium dihydrogen phosphate. The test can be conveniently carried out in a test tube by treating 1 ml. of test solution with 1 drop of 8N ammonium hydroxide and 0.1 ml. of 0.2N reagent, adding 96 per cent alcohol to obtain a syrupy precipitate which only disappears on shaking. When lithium is present a white precipitate will be obtained on boiling. Thousand-fold amounts of potassium and ammonium render the test slightly less sensitive, but the other alkali metals do not interfere in any way. The limit of detection is 10^{-5}g.

Lithium, like sodium, forms a sparsely soluble yellow compound with uranyl acetates of the usual divalent metals such as zinc and magnesium.[2] Copper uranyl acetate is, however, insensitive to lithium salts,[3] and is used to differentiate the latter from sodium.[4]

Alkali arsenites in alcoholic solution have been used by Gaspar[5] for the detection of lithium. The white precipitate is not given by the other alkali metals or magnesium. Using a 5 per cent solution of sodium arsenite in ethyl alcohol Gaspar claimed that quantitative precipitation of lithium was obtained.

Alizarin Sulphonic Acid

In a review of lithium tests Karaoglanov[6] reported that alizarin sulphonic acid is a much more sensitive reagent than sodium or ammonium carbonate, sodium phosphate and sodium arsenite, and under favourable conditions 0.6 g. of lithium chloride in 10 ml. of solution could be detected, by 1 ml. of 0.125 per cent alizarin sulphonic acid solution. The reagent cannot be recommended, however, because the yellow colour tone does not entirely depend on the presence of lithium and many ions cause colour changes with alizarin sulphonic acid. It may also be noted that the colour change with lithium chloride is not very reproducible, and that the reaction requires great care in development.

In strongly alkaline solution, periodates yield a white precipitate of a complex nature, yielding a specific test of lithium.[7] A suitable reagent consists of a solution of 10 g. of potassium periodate in 100 ml. of 24 per cent caustic potash.

A microscopic test[8] based on the reaction of lithium salts with ferricyanide and urotropine (hexamethylenetetramine) to form

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yellow octahedra gives a sensitivity of 0.06 μg. at a dilution of 1 : 50,000 and is unaffected by the present of other metals of the sodium group.

The comparative insolubility of lithium stearate has been used by Caley[9] as the basis of a test for lithium in the presence of the other alkalis. The lithium chloride was extracted with amyl alcohol, and the lithium precipitated by addition of ammonium stearate. Very small amounts of lithium yield a turbidity.

Ferric Iron Complex

As with most other di- and trivalent metals, periodates form an insoluble compound with ferric iron. This is soluble in excess of potassium periodate and caustic potash, and the solution forms an excellent reagent for lithium which alone of the alkali metals forms a precipitate with it. The precipitate is yellowish-white and is specific for lithium even in the presence of high concentrations of other alkalis.

Concentrated sodium solutions do not give precipitates in the cold, but precipitates are formed at boiling temperature. Between 45-50° C. even very minute amounts of lithium induce considerable precipitation of sodium, and this has been used by Feigl[10] to modify the original test proposed by Procke and Slouf,[11] thus increasing the sensitivity of the test. Ammonium salts interfere by lowering the alkalinity, and must be removed by boiling with caustic potash, or by ignition to dryness.

Bivalent metals generally form precipitates with the reagent, but they can be removed by precipitation with oxine, and the test performed in the filtrate. By Feigl's procedure the limit of identification is 0.1 μg. at a concentration limit of 1/500,000. The whole precipitate has the composition $FeLiKIO_6$.

Kuznetsov's reagent[12] (1-[*o*-arsenophenyl-azo]-2-naphtol-3,6-disulphonic acid) gives a yellow-orange colour with lithium salts in slightly alkaline solution, but the reagent cannot be recommended, as in the absence of lithium the reagent itself is red. Kuznestov was able to detect as little as 1 μg. of lithium in 1 ml. of solution, however. The alkaline earths, beryllium, nickel and cobalt interfere seriously.

White and Lowe's[13] reagent 1-amino-4-hydroxyanthraquinone gives a bright red fluorescence with lithium salts when irradiated with ultra-violet rays. The method is suitable for lithium concentrations of the order of 0.007 g./10 ml. Beryllium behaves similarly, and this was also noted by Sandell[14] who used morin as his fluorescence reagent. Gato[15] detected lithium by the green fluorescence of the triple acetate salt of lithium, zinc and uranium.

Separation of lithium from other members of the alkali metal group is nearly always based on the solubility of lithium chloride in organic solvents. The other alkali chlorides are on the whole much less soluble.

Kahlenberg and Krauskoff[16] separated lithium from the other alkalis by using anhydrous pyridine to extract the mixed chlorides. It was found that two extractions were necessary to ensure complete separation as the other alkalis retain lithium chloride with great tenacity.

Until recently the isoamyl alcohol method of Gooch[17] enjoyed the most popularity. 10 ml. of alcohol dissolve 0.75 g. of lithium chloride, 0.0004 g. sodium chloride and 0.0005 g. of potassium chloride while rubidium and caesium are soluble only to the extent of 0.0009 g. even in hot alcohol.

Since the boiling point of the solvent is considerably higher than that of the aqueous layer, the latter may be completely evaporated, and the salts dehydrated without much loss of solvent. Winkler[18] proposed that isobutyl alcohol be used in place of isoamyl alcohol on the grounds that 10 ml. dissolved only 0.0005 g. of the other alkali chlorides, and because it is more hygienic. Dioxan[19] completely extracts lithium chloride from potassium and sodium chlorides. One of the earliest methods for separating lithium from sodium and potassium depended on extraction with a mixed ether/alcohol solvent,[20] which method has been recently re-examined,[21] without finding much favour, however.

Other Solubility Separations

Acetone,[22] absolute alcohol saturated with hydrogen chloride,[23] absolute alcohol saturated with hydrogen chloride/ether mixtures,[24] amyl alcohol/pyridine[25] and *n*-butyl alcohol[26, 27] have all been used with varying degrees of success, but perhaps the best method is that evolved recently by Caley and Axilrod[28] who noted that solubility of sodium and potassium chlorides decreases progressively as the series from methyl to

amyl alcohol is ascended, and decided that those solubilities might be very small in the higher alcohols while the lithium chloride was still appreciably soluble.

The solubility in *n*-hexanol and 2-ethyl hexanol was found to be particularly suitable. Although the solubility of the lithium chloride is reduced from 7.3 g. in 100 ml. isoamyl alcohol to 3.0 g. in 100 ml. of 2 ethyl hexanol, the solubility of the sodium chloride was reduced from 1.6 – 0.1 mg., and the solubility of potassium chloride from 0.6 – 0.01 mg. In using their reagent, Caley and Axilrod found that it was necessary to restrict the temperature of dehydration to 50° C. below the boiling point, in order to prevent formation of insoluble lithium hydroxide.

In the following paragraphs the most common methods of determining lithium are reviewed under the heading of salt and lithium which is weighed or isolated for titration.

Procke and Slouf[11] found a new precipitant for lithium in potassium ferric periodate, and from this developed a new volumetric method. The precipitant consists of a strongly alkaline solution of ferric periodate in potassium periodate, which is added to the lithium solution made alkaline with potassium hydroxide to a normality of 0.8 – 1.0. Lithium is precipitated as $LiKFeIO_6$ and is estimated iodometrically by titration with arsenious acid.

Potassium, rubidium and caesium do not interfere but a considerable amount of sodium is co-precipitated, yielding high results. Sodium was separated out from concentrated solutions with ethanol saturated with hydrogen chloride. Sodium dissolves only slightly in this medium and the lithium can be extracted completely without appreciable contamination from sodium. The authors found considerable difficulty in obtaining potassium hydroxide which was substantially free from sodium.

Acidimetric Determination

Polyanichka[29] has proposed an acidimetric method for the determination of lithium carbonate in the presence of sodium and potassium. The alkalis are converted to the normal carbonates by evaporating with oxalic acid. The method is based on the titration with hydrochloric acid of total carbonate in one portion to a methyl orange end point, and titration of sodium and potassium carbonates in another portion after separation of K and Na with ethanol saturated with lithium carbonate. The method is tedious and has not found wide application.

The oldest method for the determination of lithium, due to Mayer,[30] is based on weighing lithium phosphate after separating it from the other alkalis in the presence of sodium hydroxide. Procke and Slouf[11] criticise this method and confirm Rammelsberg's findings,[31] that there is considerable co-precipitation of sodium, nevertheless Hackl[32] has used the phosphate as weighing form in his determination of the lithium content of mineral waters and silicates.

Silicates

In dealing with silicates, the alkali chlorides were isolated in the usual way and the potassium precipitated as platinichloride. The excess platinum was removed with hydrogen and the solution treated with sodium hydroxide and 8-hydroxyquinoline to remove magnesium, before precipitating and weighing the lithium phosphate.

In mineral water analysis, the lithium was extracted by the isobutyl alcohol method of Winkler.[18] Instead of converting to the sulphate and weighing as such, Hackl found it best to remove any magnesium present by neutralisation with sodium hydroxide, evaporate to dryness with hydrochloric acid, fume off the acid, dissolve the residue in 3 ml. of strong ammonia and precipitate the lithium as phosphate in the presence of ethyl alcohol. Duval,[33] in his investigation of the thermogravimetry of precipitates, found that the minimum temperature of ignition of the precipitate was 450°C.

When investigating the various methods of determining lithium, Grothe and Savelsberg[34] found that erratic results were obtained by the fluoride, phosphate and triple acetate methods. In one case it was only possible to obtain 39 per cent recovery. In an attempt to discover a more favourable method of analysis, they found that lithium could be precipitated from strongly alkaline solution as the aluminate without interference from magnesium or the other alkali metals.

The reagent is made up by dissolving 50 g. of potash alum in 900 ml. of hot water and adding a concentrated solution of 20 g. of sodium hydroxide until the aluminium hydroxide re-dissolves. The solution is

allowed to stand overnight and the *p*H is adjusted to 12.5 – 13.

The *p*H of the sample solution is brought to 3 and 40 ml. of the prepared reagent are added per mg. of lithium. The *p*H is then brought to 12.6 by addition of a few drops of sodium hydroxide, and the solution allowed to stand for some time before filtration. The residue is washed until the washings are no longer alkaline to phenolphthalein and the precipitate ignited [25] at a temperature exceeding 471° C., and weighed as $2Li_20.5A1_20_3$.

Gravimetric Determination

Gravimetric determination of lithium as its sulphate has never achieved any degree of popularity since it involves the tedious process of separating the alkalis from the other metals and the removal of the other alkalis by extraction, and ammonium by ignition. The method is, however, used for the analysis of certain types of material.

For the determination of the lithium content of sea water,[25] for example, magnesium was removed with sodium hydroxide, sulphate by benzidine, traces of magnesium were removed by calcium hydroxide and the excess calcium removed with ammonium carbonate. The last traces of calcium were removed by ammonium oxalate and the last traces of magnesium by 8-hydroxyquinoline. Sodium and potassium were removed as chlorides by treatment with a mixture of amyl alcohol and pyridine, and the lithium converted to sulphate and weighed as such.

Kallmann[27] has used the sulphate method for determining lithium in minerals. The opening out procedure was based on the methods of Berzelius and Lawrence Smith. The pulverised sample was repeatedly evaporated with hydrofluoric acid, then digested with hot water and rinsed into a flask containing calcium oxide. The solution was boiled and filtered and the residue examined as in (2).

(1) Ammonium hydroxide and carbonate were added to the solution to remove calcium, and the residue from filtration combined with the first residue.

(2) The combined residues were heated with ammonium chloride until a sintered mass was obtained. The sintered mass was digested with water and the residue discarded after filtration. As previously the filtrate was treated with ammonium carbonate.

The combined filtrate from (1) and (2) now containing all the alkali chlorides, was evaporated to dryness with perchloric acid and the residue heated to 350° C. before extracting the lithium with *n*-butyl alcohol containing hydrogen chloride. The lithium was converted to normal sulphate and weighed as such. Duval[23] found it satisfactory to ignite the sulphate at a temperature exceeding 160° C. but others[26] have claimed that the temperature must be greater than 470° C.

Carnot[27] first utilised the insolubility of lithium fluoride to separate it from the other alkali fluorides and to determine lithium gravimetrically, but solubility corrections are necessary and the latter vary to a great extent, so that the method has never proved popular, although as recently as 1948 a paper has appeared on the determination of lithium as fluoride in the analysis of the minerals spodumene, petalite and lepidolite.[28] Other workers[29] using a gravimetric sulphate finish have preferred to separate as the insoluble fluoride before weighing as sulphate, to avoid extraction with an organic solvent.

Bacon and Starks[40] have employed the periodate procedure of Rogers and Caley[7] to the determination of lithium in silicates and glass. The material was attacked with sulphuric and hydrofluoric acids, and the residue extracted with water. Iron, aluminium and chromium were removed by careful addition of ammonium hydroxide. Manganese was removed as manganese dioxide by treatment with persulphate, and calcium by precipitation as oxalate. Finally magnesium was removed by oxine and the lithium precipitated as periodate.

Lithium periodate was filtered off, dissolved in hydrochloric acid, and finally titrated with thiosulphate after addition of potassium iodide.

Triple Acetates

Like sodium, lithium forms insoluble triple acetates with uranium and divalent metals such as zinc magnesium, etc. The composition of the precipitate corresponds to $LiM(UO_2)_3(C_2H_3O_2)_9.6H_2O$ where M denotes a divalent metal. Miller and Traves[2] determined lithium gravimetrically in this way. The solubility of the precipitate is about 30 per cent greater than the solubility of the sodium salt, but nevertheless good results were obtained by these workers in the analysis of silicates.

Others[41] have preferred to determine

lithium gravimetrically as the triple acetate after separation from sodium by precipitating as carbonate. Chernikov *et al*[42] have developed the use of zinc uranyl acetate for analysis of the lithium content of light alloys. The Mg/Al alloy is dissolved in 1-2 N.HCl and the lithium in this solution precipitated and allowed to stand overnight. The precipitate is weighed after washing with reagent and alcohol saturated with lithium zinc uranyl acetate, and drying for 5 minutes at 80-90° C. Only 80 per cent recovery was obtained when the aluminium content was high.

Nickel, cobalt, zinc, calcium, iron and cadmium did not interfere. No mention is made of sodium. The uranyl acetate method has also been used for the analysis of drugs and mineral waters,[43] the recoveries for amounts of lithium from 1-5 mg. being from 97.5-103.9 per cent.

Some amino-carboxylic acids such as nitrolotriacetic acid, uramildiacetic acid and ethylene diaminotetracetic acid form stable complexes with the alkaline earths, sodium, lithium and other cations. The formation of these stable complexes can be used for determining the cations. Schwarzenbach[44] has developed a titrimetric method for lithium, by titrating to a definite *p*H in presence of a suitable indicator which gives a colour with the cation.

Radioactive Method

Japanese workers[45] have developed a radioactive indicator method for lithium. The lithium is precipitated as the insoluble phosphate, and this is dissolved in sulphuric acid. The phosphoric acid thus liberated is precipitated with radioactive lead acetate containing thorium B, and the activity of the filtrate measured. A calibration graph (mg. Li/activity of filtrate) previously prepared against known amounts of lithium is used to evaluate the lithium content of the original sample.

An electrometric method based on titration with barium hydroxide has been proposed recently.[46] The method is based on measuring the *p*H, at which the hydroxide of various metals are formed. Titration curves have been established for lithium. sodium, ammonium, potassium, magnesium and calcium.

A recent paper[47] has described the estimation of the lithium content of rocks by straight distillation of the chloride. This utilises the high volatility of the lithium salt as compared to the chlorides of the other alkali metals. The finely powdered rock mixed with calcium carbonate and calcium chloride, was heated in a platinum boat at 1,200° C. in an air stream for half an hour, and the volatile lithium chloride collected on a cold plug of glass wool. Some calcium oxide or chloride also passed over, and 98.7 per cent recovery of lithium was obtained. Although the method is valuable as a means of concentrating the lithium salt, it can hardly be recommended as a method of analysis.

β-Naphthylamine[48] has been recommended as a lithium precipitant, but no mention of the behaviour of sodium and potassium under identical conditions has been made, and no further work on the method has appeared.

Spectrographic Determinations

It is outside the scope of this review to deal at any length with the spectrographic determination of lithium and only a few brief notes on the subject need be made here.

In Russian journals of recent years, much space has been devoted to the influence of foreign materials on the spectrographic determination of lithium. Borovik and Brozhnikova[49] found that sodium and potassium chlorides and hydrochloric acid augmented the intensity of the lithium lines, and the increase was observed to be more pronounced with higher proportions of the other substances.

Sodium and potassium chlorides have a greater effect than hydrochloric acid, and the increase of intensity was used by these authors to determine lithium in concentrations of as little as 0.00025 per cent.

The effect of the total composition of soils on the intensity of the lithium spectral lines, particularly with regard to the influence of sodium chloride, potassium and calcium chlorides has been investigated by other workers.[50]. The influence of the alkali chlorides was particularly marked on the 6707.7Å line, high analyses being obtained. In a series of spectra taken by shifting the plate every 30 seconds it was found that in the case of soil and soil + sodium chloride the 6707.7Å line appears only in the first three spectra while in soil + sodium sulphate the line appears only on the fourth, fifth and sixth spectra.

In a later paper, Borovik[51] *et alia* examined the relative effect of various foreign materials on the intensity of the 6707.7Å line of lithium. Sodium phosphate, acetate, oxalate and carbonate failed to intensify the line. Similar results were obtained with a D.C. arc. In the analysis of soils it was found that a given amount of potassium chloride increased the lithium content apparently six-fold while the same amount of sodium effected a four-fold increase. The presence of cuprous and cupric chlorides diminished the intensity of the line. When calcium sulphate was the lithium-bearing material, it was observed that sodium sulphate was more effective than sodium chloride in augmenting the intensity.

Clay Analyses

Iwamrau[52], analysing the lithium content of clays, found the 6707.8Å line to be more sensitive than 6103.6Å, and obtained a sensitivity of 3×10^{-5} per cent. Gazzi[53] preferred flame spectra spark and arc spectra, finding the first to be less liable to interference from foreign materials.

Again the 6707.8Å line was used, but Rusanov and Alekseexa[54] preferred the 6103.6Å line to analyse solutions and minerals. In the presence of other alkali metals these authors claimed a probable error of ± 4.6 per cent within the concentration range 0.001-0.2 per cent. Some workers[55] have deposited lithium on a mercury electrode which was subsequently spectrographed. In this way they were able to determine as little as 1 μg. of lithium.

Lithium content of plants has been analysed by Kent[56] by an adaption of the Ramage method. This consists of feeding a paper spiral on which the lithium is absorbed, on a horizontally sliding piston actuated by a hand wheel, through the outer cone of a flame until it begins to burn brightly at the edge of the inner cone.

Portland cement has been analysed by Helz[57]. The crushed sample was mixed with three times as much of a powder containing 70 per cent graphite and 30 per cent strontium carbonate. The strontium serves as an internal standard. Results correct to within 0.06 per cent of the weight of sample taken were obtained for samples containing more than 0.05 per cent of lithium.

Oplinger[58] has carried out the spectrochemical analysis of lithium ores using a 2,200 V. arc. The sample was fused with potassium carbonate and the cooled melt extracted with water containing sulphuric and hydrochloric acids. Ammonium molybdate was added as internal standard, and the solution made up to a definite volume. 0.05 ml. of this solution was transferred to the carbon electrodes and the spectrogram recorded after drying and pre-burning for 20 seconds.

Ceramics were analysed by Jaycox[59], mixing the powdered sample with 10-100 parts of a suitable metallic oxide such as quicklime. Carbon dust was added for its additional buffing action, and spectra obtained for the unknown and an appropriate standard.

Several workers have investigated the polarographic determination of the alkali metals. Heyrovsky[60] and Ilkovic, Majer[61] and Peracchio and Meloche[62] have studied the effect of both solvent and supporting electrolyte. Since the alkali metals yield waves at very negative potentials, the tetra-alkyl ammonium halides or hydroxides are the most suitable electrolytes.

Tetramethyl ammonium hydroxide has been advanced as most suitable, but Kolthoff and Zlotowski[62] found the tetraethyl derivative to be superior since the latter ion is not discharged until a further 0.2 V. is applied above the corresponding tetramethyl potential. This is particularly important in the determination of lithium since it is very difficult to get a well defined diffusion current with tetramethyl ammonium hydroxide even in relatively concentrated alcoholic medium.

Interpretation of Results

Lithium can best be determined in an 80 per cent alcoholic medium with an electrolyte concentration fifty times greater than the amount of alkali present. Both sodium and potassium yield well defined curves. In a mixture of potassium, sodium and lithium salts, two diffusion currents are obtained. The first corresponds to the sum of sodium and potassium and the second to the lithium concentration.

Russian workers[64] have determined the lithium content of natural waters polarographically. The optimum concentration of lithium was from 5×10^{-4} to 10^{-5} g. When the concentration of tetramethylammonium hydroxide exceeded 0.1N a broken lithium wave was obtained, and at concentrations lower than 0.01N the wave became non-uniform.

Calcium was found to interfere with the determination of lithium. A separation was achieved by evaporating the solution to dryness and extracting with acetone + hydrogen chloride. The extraction was repeated 5-6 times and the combined extracts evaporated to dryness with 1/1 sulphuric acid. The dry residue was dissolved in water and the appropriate amount of tetramethyl ammonium hydroxide added. The solution was analysed after standing for 30 minutes.

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To Double Aluminium Output

THE Norwegian Government has published its plans for the construction of a large new aluminium plant at Sunndalsöra in West Norway. The plant will have a capacity of 40,000 tons a year which is almost as much as Norway's total present output of aluminium. It is estimated that it will take 4 to 5 years to build the plant. The capital requirements for the plant itself are estimated at £12,500,000 on the basis of prices prevailing in the first months of 1951. In addition almost another £5,000,000 will be needed to increase the capacity of the Aura hydro-electric plant which would supply power to the factory.

The plans for the new aluminium plant are subject to funds being made available from ECA in foreign currency for the purchase of machinery and equipment abroad against repayment in the form of aluminium. Total expenditure in foreign currency for the aluminium plant and the power station is put at $18,500,000. Altogether it is proposed to borrow a sum equivalent to £10,300,000 to be paid back over a period of 10 years at the rate of about £1,300,000 a year in amortisation and interest. At present prices this would correspond to about 9,500 tons of aluminium a year, and leave a large surplus for free sale.

The Norwegian Government has during 1950 and 1951 been in negotiation with ECA and provisional agreement has been reached on a financial contract with regard to loan and repayment.

New Titanium Alloys

From a Special Correspondent

ALLOYS of titanium with antimony may be conveniently prepared by pelleting a mixture of the pure powdered metals and heating in a sealed tube of ceramic material at 1300-1600°C. The alloys are then quenched in water and annealed at 600° C. for 60 hours. Samples containing 33.3, 40, 50, 60, 66.6, 75, and 80 wt.-per cent of titanium were prepared and subjected to both thermal and X-ray analysis. Formation of $TiSb_2$ was definitely established by these methods, while the X-ray technique also revealed the existence of TiSb as well as of at least one phase richer in Ti. In addition, metallographic examination showed that with increasing content of titanium two-phase fields were formed with the compositions Sb + $TiSb_2$; $TiSb_2$ + TiSb; and TiSb + Ti_4Sb. Other features divulged by X-ray analysis were that no lattice expansion of antimony occurs during the alloying process and that titanium is not soluble in antimony. It may be noted that a simpler method of preparing the alloys with a higher antimony content consisted in heating the mixture of powdered metals in an open crucible under a protective layer of a salt.

Titanium-lead alloys were similarly prepared and subjected to microscopic and X-ray examination. The maximum Ti content was 62.5 wt.-per cent and the X-ray analysis showed that up to this concentration only a single titanium-rich phase existed side by side with lead. Samples corresponding to Ti_4Pb were homogeneous under the microscope.

* Nowotny and Pesl, Monatshefte für Chemie, 15th April, 1951, pp. 336-47.

Manganese Recovery

New Process Developed in U.S.A.

CURRENT expansion of U.S. steel production gives rise to the need for ever-increasing quantities of manganese which is essential in the manufacture of steel. American steel companies and the U.S. Government are, therefore, developing new processes for recovering manganese from domestic sources of supply.

Development of an inexpensive method for recovering manganese from open-hearth furnace slag has been reported by the U.S. Bureau of Mines. Steel companies are expected to begin using this method soon.

A small experimental blast furnace at Pittsburgh, has been operating since March, 1951, to recover manganese from slag. Potential recovery by the industry has been estimated at about 400,000 short tons, or 68 per cent of the manganese used in U.S. steel production in 1950.

The Bureau also is developing refining processes to treat low-grade ores found in large quantities in the State of Georgia. Several successful methods have been devised for improving the manganese content of the ores. This is expected to increase the over-all usable and recoverable reserves of ore in this State alone from 200,000 short tons to 800,000 tons.

America at present depends largely on imports to meet its industrial needs. Domestic production of high-grade ore totalled only 139,000 short tons in 1950, a 10 per cent gain over 1949 output. Imports of high-grade ore were 1,837,950 tons in 1950, compared with 1,544,525 tons in the previous year. India, South Africa, and the Gold Coast furnish most of the imports.

Consumption of manganese ore by manufacturers of steel alloys totalled 1,520,494 tons in 1950. Consumption of ferro-manganese, which is used to make steel ingots and castings, reached a new high level of 764,805 tons.

Conserving Strategic Metals

SAVING in the use of such strategic materials as cobalt, columbium and nickel is expected as a result of two new alloys which have been developed by the Crucible Steel Company, New York. Both alloys are stainless and will resist extremely high temperatures. Possible applications are in aircraft engine parts and industrial equipment.

One of the alloys, designated as CSA39. has an iron base and contains about 27 per cent nickel, 18 per cent chromium, 9 per cent molybdenum and 3 per cent tungsten. It can be used at temperatures between 1,300° and 1,600°F.

The other, called Crucible 422, also has an iron base. It contains 13 per cent chromium, 1 per cent tungsten, 1 per cent molybdenum, less than 1 per cent nickel, and less than 5 per cent vanadium. It can be used at temperatures of 1,000° to 1,100°F.

High-Vacuum Electric Furnace Processes

Purity Obtained by Diet Volatilisation

ONE of the war-time research developments which now shows signs of large-scale expansion is the smelting of ores and residues of the rarer metals in the vacuum electric furnace. In pre-war days this system was almost entirely relegated to laboratory experimental work, where the charges dealt with amounted to little more than a few grams, with the notable exception of tantalum which at all times necessitated use of the vacuum electric hearth.

As a result of the data recently collected, a number of what are normally regarded as high melting point metals are now readily fused, and also lend themselves to methods of separation formerly unknown. It was earlier considered that this system could only be used primarily as a melting and not a refining method, since the need for maintaining the high vacuum forestalled any possibility of slagging treatments and so on. While this is true up to a point, quite a few of the elements present in ores can be distilled off, and this opens up a means of separation which will no doubt be widely explored in the near future.

This work is not to be confused with the distillation smelting of molybdenum which depends on the volatility of the oxide, and not the metal. In this process, the roasted ore is dealt with in a glow-bar type of hearth, where air is allowed to pass freely over the almost white hot material. The high vacuum process operates in the opposite direction, that is, it completely obviates the presence of the slightest trace of air or gas from outside sources. For example, whereas scrap brass can be oxidised in the converter to burn out the majority of the zinc, the crude form of blister copper so recovered necessitates final electro-refining to eliminate remaining zinc, and also get rid of most of the occluded gases.

For High Cost Metals

Work has already been done in preparing almost perfectly pure copper for electrical purposes by vacuum casting, but for the most part it is the metals already high in cost which are smelted, and the little extra expense of rendering perfectly pure can be easily stood. This additional cost can run from two to three pence per pound of metal vacuum melted, but the ingot obtained is almost practically free from the shrinkage on top caused by cooling, commonly known as the 'pipe'.

Aluminium is one of the few metals which have not been successfully dealt with by this process because it tends to retain a perpetual oxide skin, which prevents production of the almost 100 per cent purity usually attained.

Used for Tantalum

For nearly half a century, the metal which was regularly melted by the high vacuum electric furnace was tantalum, which if melted in the air could absorb not only oxygen, but nitrogen, carbon dioxide, hydrogen, and in fact almost any gas, the product being rendered unsuitable for rolling or otherwise fabricating.

Improved types of vacuum electric furnaces depend mainly on the use of high-frequency electrical induction units as the source of heat, and on two different arrangements for maintaining the vacuum.

In the first of these, or the roughing pump, the main body of the air is exhausted. The second pump, known as the finishing or diffusion pump (which contains oil or mercury) not only removes any remaining trace of air, but also seals the hearth against any possibility of returning air. There are various small constructional details unique with specific designs, such as the use of selected plastics and rubber compositions for gaskets for making certain of this sealing at convenient points on the exterior.

In a similar way, differing arrangements are employed for housing the small ingot mould within the precincts of the chamber where the actual hearth is also located, so that it is impossible for air to enter until the cold ingot is finally removed.

By one method, a piece of metal of high melting point is used as a plug but is so situated that it does not receive the full heat of the hearth and remains un-melted, until a separate induction coil is brought into action which melts this plug, and allows the remainder of the mass to be run into an enclosed mould. In another arrangement,

the ingot mould, made of refractory material, is suspended internally from the trunnions, that is inside the chamber where the furnace itself is located. When the whole is tilted to tap, the suspended mould remains in truly vertical position until the ingot has been cast. For this purpose, the chamber is tilted with the assistance of double square-threaded screws to ensure a steady consistent movement. The mould, which is exposed to the full heat throughout, cannot always be lined with any of the usual lamp-black or other fine carbon linings, etc.

Processes Versatile

Some indication of the versatile nature of the processes which can be performed is seen in the means of distilling off impurities such as selenium, tellurium, and sulphur from copper, rendering nickel almost absolutely pure, de-gassing chromium and manganese, and preparing pure calcium and barium on a commercial scale.

Prior to the war, the production of lithium depended upon a preliminary fusion of lepidolite to form an upper layer of potassium and lithium sulphites. This was lixiviated with water, converted to chlorides by adding barium chloride, evaporated, and the lithium chloride extracted by a mixture of ether and alcohol, after which the metal was obtained by electrolysing in a pyridine solution.

Today, using the high-vacuum process, metallic lithium can be reduced from the ore spodumene in one operation, at a mere fraction of its earlier cost. It transpires that fractionating columns have also been used to separate out sodium and potassium from other lithium-bearing materials, using the same high-vacuum principle.

With manganese and chromium, instead of the elaborate preliminary wet extractions to ensure the ultimate smelting giving a pure product, pressures as low as 10^{-3} mm. and temperatures of 3.650° F. permit impurities to be distilled off to give the pure metals directly.

Chromium produced by vacuum sublimation shows 99.95 per cent purity, and far from being the brittle metal usually described, can be deformed by hammering without fracturing. Nickel can be obtained softer and more ductile than the purest metal at present available, and is considered excellent for electronic tubes and other vacuum tubes, for which purpose 100 lb. ingots are already being supplied.

For magnets, where purity is so important, vacuum melted iron shows as little as 0.005 per cent carbon and 0.0005 per cent nitrogen. With copper, although commercial electro-refined metal contains only 0.00045 per cent oxygen, when vacuum-cast this is further reduced to 0.00039 per cent, with other gases reduced to half their normal content.

Except in tensile strength, physical properties are improved, elongation showing 17.3 per cent in place of 20.3 per cent, reduction in area 76 in place of 88 per cent, and better electrical conductivity. Research is at present in progress to produce a more ductile aluminium to permit deeper drawing for collapsible tubes, etc.

Before the war the Germans were known to be using 6-ton vacuum electric furnaces for producing nickel-chromium, and other specialised alloys. Although such large hearths have not so far been developed elsewhere, progress has been made using pressures as low as 1/760,000 atmospheric pressure, while at temperatures 1,000° C. below their normal boiling point, metals can be made to volatilise, which gives some indication of the scope for future developments.

Briefly, instead of separations of impurities depending upon oxidising, fluxing, and other known treatments, direct volatilisation or boiling out can now be applied to otherwise high melting point elements, and provides a purity hitherto unknown.

U.S. Cyclotron Operating

THE largest fixed frequency proton cyclotron in the world, an 86-in. atom-smasher at Oak Ridge, is now reported to be in full operation. It is the first cyclotron to be installed vertically instead of horizontally, also the first of its type to be operating at over 20 million electron volts, say laboratory spokesmen. Accelerated by the magnetic field, this means that protons moving in a circular path attain a speed of more than 30,000 miles a second. Up to 250,000 volts can be used in the machine, and concrete walls and a roof 5 ft. thick weigh about 2,000 tons. It is operated from a control room 400 ft. away and the yoke of the magnet contains 1,000 cu. ft. of steel weighing 250 tons.

The Chemist's Bookshelf

ELECTROPLATING FOR THE METALLURGIST, ENGINEER AND CHEMIST. By J. B. Mohler and H. J. Sedusky. Chemical Publishing Co., Inc. New York. 1951. Pp. 257. $5.00.

This book discusses all the important aspects of practical electroplating without going into the involved details of electrochemical theory. The necessary fundamentals, such as voltage, polarisation and current distribution, are discussed, but they are presented in simple, non-technical language, so that even electroplaters without scientific or technical background will profit by using this book.

The 25 chapters deal with the characteristics of plating baths, the behaviour of electric current during plating, the deposit, the composition of common plating baths, control methods and analytical procedures. Some chapters are devoted to alloy plating, continuous plating, diffusion coatings, copper plating for selective carburisation and to commercial applications. The operating details are described in the light of recent improvements and each chapter contains comprehensive references, which, together with a glossary and subject index, will be valuable to the student. This is a well-written and informative treatise.—F.N.N.

SILICATE ANALYSIS. By A. W. Groves. Second edition. George Allen & Unwin, Ltd., London. June, 1951. Pp. XXIII + 336. 25s.

The second edition of this book, first published in 1936, represents a manual for geologists and chemists which, according to a foreword by Professor Arthur Holmes, 'contains a wealth of information, that will prove invaluable to analytical chemists, mineralogists and petrologists'. It provides a practical and up-to-date handbook for the analysis of rocks and silicate minerals—both natural and artificial—used in industry.

The needs of various types of workers are considered—the analyst with no special training in petrology; the analyst who is both a chemist and a petrologist; and the geologist without special training as an analyst, who requires to understand the methods of silicate analysis so that he may be able to guide the analyst in his work. 'Silicate Analysis' thus differs from previous books dealing with the chemical analysis of silicates in that, in addition to the chemistry, it also gives the requisite amount of mineralogy and petrology. The scattered knowledge of the subject is usefully correlated in this volume, which covers both the theoretical and the practical aspects.

The author, who is associated with the Mineral Resources Division, Colonial Geological Surveys and Imperial Institute, London, combines his own experience with much information from available sources. The main chapters cover, respectively, laboratory equipment and apparatus; reagents; sampling; common operations and methods; technological applications and occurrence of the various elements, etc. The book contains many tables and illustrations and chapters on check calculations and geochemical data are appended.—F.N.

THE CHEMISTRY OF HYDRAZINE. By L. F. Audrieth and B. Ackerson-Ogg. John Wiley & Sons, Inc., New York; Chapman & Hall, Limited, London. Pp. 244. 40s.

This little book attempts to be a complete encyclopedia of the chemistry and physics of hydrazine. It possesses all the merits and suffers from some of the faults of such a work.

It deals with the formation and preparation of hydrazine in its various forms, the properties of the anhydrous compound and its solutions, determination, chemical and physical properties and uses. The merit of this book is that one can find a reference or a few lines about almost anything that has been done with regards to hydrazine. Its most palpable fault is that there is an absence of proportion. Certain subjects in which the writers have personal experience are discussed at great length even though

[*continued on page 34*

HOME

A Laminated Hard Material

In the report of the British Plastics Exhibition in our issue of 16 June, on page 908, we referred to the product 'Formica' and said that it could be used as chair and cushion covers, cloths for the kitchen, etc. This was incorrect, for in actual fact 'Formica' is not a woven plastic but a laminated hard material usually made in sheet form and based on paper or cotton material. It is used extensively for panelling in railway compartments and for making table tops, etc.

Norwegian Dicyandiamide

British Oxygen Co. have nearly completed a plant for the production of dicyandiamide at their cyanamide works at Odda, Norway, and a plant for the production of melamine from this compound is being built in Britain. The melamine project is a novel departure for the company, who describe it as the precursor of other developments. It is being undertaken partly in order to provide an alternative outlet for Norwegian cyanamide.

Gasworks Modernised

One of the most up-to-date retort houses in Britain was officially opened at Peterhead gasworks on 26 June by Provost J. A. Dickie. The town council agreed five years ago to the installation of modern carbonising plant to meet the ever-increasing demand. The plant consists of six vertical Glover-West retorts, 25 ft. long, capable of producing approximately 600,000 cu. ft. of gas per day. Allowance has been made for the addition of two further retorts, which when completed will bring the total capacity of the plant to 800,000 cu. ft. of gas a day.

Welding Congress

The first congress organised by the International Institute of Welding opens with a Government Reception at Lancaster House on 14 July. Close on 500 delegates have enrolled, drawn from the welding experts of 21 countries.

The technical meetings, which will be held in Oxford from 16 to 20 July, include open sessions for the discussion of papers on 'The Welding of Bridges and Structures', 'The Welding of the Wrought Light Alloys', and 'Recent Developments in British Welding'.

Notch Bar Testing of Materials

The Joint Committee on Materials and their Testing in association with the Institute of Welding announces a Symposium on Recent Developments in Notch Bar Testing of Materials and their Relation to Welded Construction, to be held in London on Wednesday, 5 December, 1951.

First 'Open-House'

Henry Balfour and Co., Ltd., of Durie Foundry, Leven, the well known chemical, gas and food engineers, staged their first 'Open House' day for relatives and friends of workers during Leven's Festival Week in June. The firm was showing its employees at work, for the first time in its 140 years' of active development. During the visit the entire process of work on the firms' range of specialities was demonstrated.

Another Anhydrite Plant

A large plant producing sulphuric acid from anhydrite is likely to be established at Widnes. The chairman of the United Sulphuric Acid Corporation, Mr. F. G. C. Fison, states that negotiations are proceeding for acquiring a site. Completion of the purchase is dependent upon a number of matters under discussion. The estimated cost of the project is thought to be between £3,500,000 and £4,000,000 and it is expected that the plant will produce about 150,000 tons of acid a year.

K.I.D. Exemptions

The following chemicals have been exempted from Key Industry Duty for the period 4 July to 19 August, 1951: Benzyl cellulose (a cellulose ether); cellulose acetate, where the weight of the acetyl content, calculated as acetic acid, is less than 55¼ per cent, but not less than 50 per cent by weight of the cellulose acetate, not being cellulose acetate which is an ingredient or forms part of a composite article; N,N'-diethyldiphenylurea; glyceryl triacetate (a glyceryl acetate); *i*-Inositol (a hydrogenated hydroxybenzene); naphthol; sodium 1,3,6-naphthalenetrisulphonate (a naphthalenesulphonic salt); sulphaquinoxaline (a substituted arylsulphonamide); 3,3,5-trimethyl*cyclo*hexyl mandelate (a mandelic ester).

· OVERSEAS ·

Ontario Sulphur Discovery

The Hudson Bay Mining and Smelting Company is reported to have discovered a significant deposit of sulphur during diamond drilling 10 miles east of Fort Frances, Ontario. A spokesman of the company admitted that iron pyrites were known to exist in the area near Nickel Lake, and sulphur often goes hand-in-hand with a discovery of pyrites. 'We were not there long enough to make any major discoveries of sulphur,' he added.

Tribute to American Chemists

The U.S. Postmaster General has announced that a special stamp is to be issued this year to commemorate the 75th anniversary of the American Chemical Society, which is now the world's largest professional association of scientists, having a membership of 63,000 chemists and chemical engineers. The date of issue will be about 4 September at the time when the society's Diamond Jubilee celebrations will be held in New York.

New Cortisone Synthesis?

A group of Merck & Co. scientists in the U.S.A. have reported the conversion of ergosterol, cholesterol and two other sterols into a steroid containing an oxygen atom on the 11th carbon—crucial group for cortisone—which might eventually, they say, lead to a new large-scale manufacturing process for cortisone. Considerable research is necessary yet, however, before the claim can be confirmed. The steroid synthesised is different from the one recently made by Woodward, and it resembles cortisone more closely. It is 3-acetoxy-11,20-diketo-*allo*-pregnane, a sterol derived from the two mentioned above but containing an oxygen atom on carbon 11.

Million Dollar Contract

The contract for design and construction of a sulphuric acid alkylation plant in El Paso, Texas, has been awarded by the Standard Oil Company of Texas to The M. W. Kellogg Company. Cost of the plant will be about $1 million. It will be of the most modern design, employing the cascade-type reactor and motor-driven agitators for mixing the hydrocarbons with the acid. Construction is scheduled to begin this autumn.

Iron Ore from Taconite in U.S.A.

Experimental plants for the recovery of the iron content from taconite will soon begin operations in Minnesota, the United States Steel Corporation announced recently. Plants will have an annual capacity to treat 2 million tons of hitherto useless taconite rock and produce 500,000 tons of iron ore.

Copper Ore Discoveries in Yugoslavia

Yugoslav geologists are reported to have discovered deposits of copper ore in the vicinity of the famous Bor copper mines. Deposits of copper ore, pyrite and limonite are also reported to have been found near Majdanpek in Eastern Serbia. The Bor electrolytic plant is expected to be completed within a few months' time and a new rolling mill with an annual capicity of 24,000 tons is scheduled to start operation at Sevjone next year.

Copper Allocation Urged

World allocation of copper is reported to have been recommended by the committee of the International Materials Conference meeting in the U.S.A. The suggestion is based on a questionnaire to 45 Governments, but no mention is made of price control. It is pointed out by the trade that without price control the prevailing diverge of copper prices would make world allocation impracticable.

Durban Refinery

Events in Persia have lent added urgency for the need to expedite plans for the £4.5 million oil refinery in Durban. Both the Government and the Standard Vacuum Oil Company are anxious to have the work completed as soon as possible. Durban City Council will have to provide extensive services for the 217-acre site at Wentworth. Legislative steps have already been taken to empower the company to expropriate the servitude rights and the land required for a 4½-mile pipeline from the site to the harbour. Electric light and sewerage for 500 people are required by January next, and storm-water drainage and facilities for the disposal of liquid effluent by June, 1952. A daily supply of 77,000 gallons of water is also wanted by the same date. When completed the refinery is expected to handle 10,000 to 15,000 barrels of oil a day.

Publications & Announcements

RAPID tinning of small aluminium and aluminium alloy articles is made possible by an ultrasonic soldering bath recently introduced by the Equipment Division of Mullard, Ltd. This unit has been developed specially for soldering small and complex shaped parts which cannot easily be handled by the Mullard ultrasonic soldering iron. The ultrasonic transducer which forms the basis of the soldering bath, makes use of the phenomenon known as magnetostriction which is connected with the small dimensional changes that occur in ferro-magnetic materials when they are placed in a magnetic field. In the new soldering unit the rapid vibration of the bath, resulting from the magnetostriction effect produced in the transducer, is used to break up the highly refractory oxide films which normally form easily on such metals as aluminium.

* * *

AN interior wall paint which can not only be applied direct to actively alkaline surfaces such as new cement renderings, plaster or asbestos cement without the necessity of previous sealing treatment, but can also be safely used when they are slightly damp has been developed by Factron Products, Ltd.

This chemically resistant coating is available in a range of attractive pastel shades especially for interior decoration of factories, offices, canteens and other buildings. It dries to a smooth matt finish which is extremely durable, washable and non-flaking. It is said to be a complete paint system as no special undercoating is required and two coats are quite sufficient for most purposes

* * *

IN the brochure on high-nickel alloys, Henry Wiggin & Co. describe the high-temperature behaviour, specifications and many applications of five of their nickel alloys, Nimonic 75, Inconel, Nimonic D, Malleable Nickel, and Mangonic. These alloys not only resist progressive oxidation, claim the company, but also possess good mechanical properties at high temperatures, so that failure of heat-treating equipment due to sagging, distortion, etc., is minimised, and the necessity for large heavy structures which wastefully absorb heat is reduced. Furthermore, the range of materials now available will, say the firm, meet a wide variety of operating conditions.

THE extraordinary range of application of the punched card accounting system is demonstrated in a short publication issued recently by the British Tabulating Machine Co., Ltd. Showing how the cards are punched originally and then fed into machines capable of extracting almost any information in any order at very high speed, the booklet shows a range of machines and stresses that each one is 'tailor-made' to conform to the needs of each particular customer. This brochure on 'Hollerith' accounting machines, say the company, is aimed at filling a gap by explaining in the simplest terms the whole intricate subject of punched card accounting, and its possible uses throughout industry.

* * *

THE latest in the series of lectures, monographs and reports, issued by the Royal Institute of Chemistry is a copy of a lecture on statistical methods, with special reference to analytical methods, by D. R. Read, B.Sc., F.R.I.C., F.I.S. Mr Read deals with the fundamental concepts of his subject and endeavours to inculcate a statistical approach to analytical matters by displaying the theoretical background and describing the elementary practical calculations in detail. The lecture is designed as a guide to recognising the statistical nature of certain problems and performing the appropriate statistical operations on them.

* * *

RADIOACTIVITY as an aid to the oilfield technician is the subject of an article in the June issue of 'Naft' magazine (Vol. XXVII, No. 3), published by the Anglo-Iranian Oil Co., Ltd. The Kent Oil Refinery on the Isle of Grain, the promontory formed by the confluence of the Thames and the Medway is also described and there is an artist's impression, in colour, of the refinery as it will appear on completion.

* * *

BRITISH technicians first made the gas turbine a practical proposition. A survey of the history, development and research work at present being carried out by the industry in Britain is contained in a brochure 'The Story of the British Gas Turbine', published by Power Jets (Research and Development), Ltd., in collaboration with the leading manufacturers.

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· PERSONAL ·

MR. L. RUSSELL MUIRHEAD, whose election to the Board of Ernest Benn Ltd., publishers, was announced in our last issue, was educated at University College School, London, and Christ's College, Cambridge. His father, the late Mr. Findlay Muirhead, founded the well-known series of travel companions, The Blue Guides, which have long been published by Ernest Benn Ltd., and Mr. Russell Muirhead is editor of the series, to which he has devoted his full energies since he left Cambridge, save for one break. That break, as indicated in our note a week ago, was in the war years, when he assumed the editorship of THE CHEMICAL AGE and formed many new friendships in the field of industrial chemistry and the chemical engineering and plant industry.

Mr. Muirhead

The Directors of Esso Petroleum Company, Limited, have announced that MR. LEONARD SINCLAIR has been elected chairman and managing director in succession to the late MR. R. A. CARDER.

It is also announced that MR. W. E. JENKINS, C.B.E. and MR. N. F. MYERS have been appointed managing directors, and MR. H. C. TETT has been appointed a director.

Mr. N. F. Myers, aged 49, is an American and a graduate of the Massachusetts Institute of Technology. He was appointed a director in 1950 and is primarily concerned with the construction and operation of the new Esso Refinery at Fawley, near Southampton.

Simultaneously with these appointments, it is announced that to administer the broad policy of the Company's rapidly expanding activities in British oil refining and marketing, an Executive Committee has been formed. Its members will comprise the Chairman, the Managing Directors, and one of the other Directors who will serve on a rotational basis.

MR. R. H. DEL MAR, M.A., F.R.I.C., managing director of Glycerine Limited, and secretary of the United Kingdom Glycerine Producers' Association, has been appointed Commercial Director to Lever Brothers (S.A.) (Pty.) Limited. He will sail for South Africa in October. He is succeeded by Mr. F. W. G. Moore, A.M.I.W.M.

Mr. Del Mar joined the Unilever organisation in 1937. He is well known among food manufacturers as managing director of Advita Limited, an appointment which he now relinquishes. From 1945-50 he was secretary to the Vitamin A Manufacturers' Panel.

MR. B. R. HOOK, former assistant to Mr. Del Mar, now becomes general manager of Advita Limited.

MR. F. W. G. MOORE, A.M.I.W.M., the new managing director of Glycerine Limited and secretary of the United Kingdom Glycerine Producers' Association Limited, joined the business of William Gossage and Sons, Limited, soapmakers, in 1927, and was manager of the Fuel and Steam Department on going to Lever Brothers, Port Sunlight, in 1932. He was appointed manager of the Glycerine Division in 1945.

Mr. Moore

The British Welding Research Association has announced the following staff changes:—

NICOL GROSS, Ph.D.(Cantab.), A.M.I.Mech.E., Mem.A.S.M.E., has been appointed Assistant Director of Research. Dr. Gross will continue his responsibility for the Association's engineering researches and will remain in charge of the Research Station at Abington.

K. WINTERTON, Ph.D., B.Sc., and H. E. DIXON, M.Sc., A.I.M., have been appointed Chief Metallurgists, the former for ferrous metals, and the latter for non-ferrous metals.

Gaskets, washers, sealing rings and packings of "Klingerit" do not fall down on the job—and on present-day oil processing installations where the temperature of the crude oil often reaches 900°F., that is saying something!

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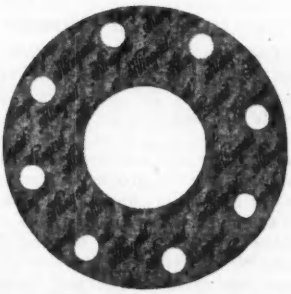

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The Chemist's Bookshelf

continued from page 27]

general interest in them is slight, while others are not treated with sufficient regard to their importance.

This refers particularly to the manufacture, its many compounds (not just salts) and uses in analytical chemistry. The role of glue in the manufacture of hydrazine has fascinated many chemists, famous and unknown, including the reviewer and is still a mystery. Is more than one chemist in a thousand interested in the observed heat capacity of solid hydrazine compared with figures calculated from the Debye Theory? This matter takes up six and a half valuable pages. A few lines would have been sufficient.

Many columns of figures given will probably undergo radical revision when it becomes more generally known that hydrazine strongly attacks glass.

In spite of these faults the volume forms a very welcome addition to the limited number of monographs dealing with a single chemical compound. In many cases the reader will be able to make progress starting with the information given in the book, in other cases he will be assisted by a monumental number of references which have been painstakingly compiled.

The book is well got up and appears to be free from obvious misprints.—S.P.S.

Market Reports

LONDON.—There has been little change in the overall position in the general chemicals market during the past week. Buying for home account and for shipment has been maintained at a steady level and a fair weight of export enquiry remains unsatisfied. Among the soda products there has been an active interest in chlorate of soda, sulphides of soda, and the technical grades of hyposulphite of soda, and the demand for bichromate of soda is much in excess of the quantities on offer. Borax and boric acid are in good request at the higher prices now ruling. Available supplies of hydrogen peroxide and white powdered arsenic are quickly absorbed and a steady outlet continues for most of the non-ferrous metal compounds. Active conditions prevail in all sections of the market for coal tar products at the higher prices reported last week.

MANCHESTER.—Recent advances in the price of chemical products, including those that came into force at the beginning of the present week, had no noticeable effect on the demand. In all sections of the Manchester market there has been a steady flow of delivery specifications and new inquiries on both home and export accounts have been reported. A shortage of supplies in a number of lines, however, still makes it difficult for manufacturers to meet requirements fully. Pressure of deliveries to pretty well all classes of tar products continues unabated. In the fertiliser market the usual seasonal slackness seems to have been accentuated by the sharp price advances that have resulted from the removal of the remaining subsidy.

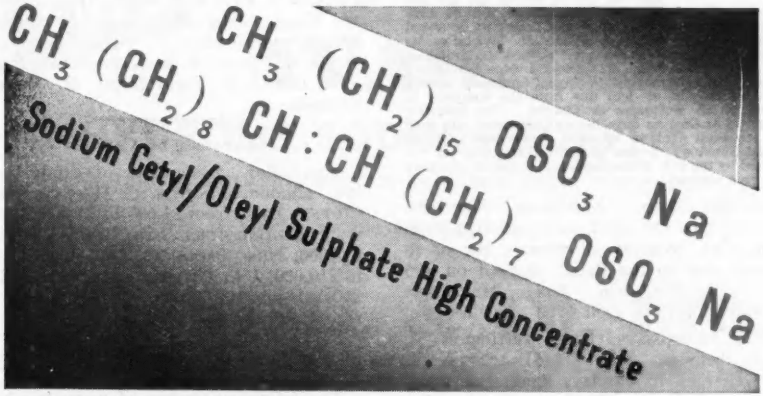
GLASGOW.—The demand for the usual range of heavy chemicals continues firm and manufacturers are hard pressed to keep pace with the orders. Derivatives of copper, zinc and manganese are still very difficult to come by but the forward position is very much brighter and the last quarter of the year will probably see these products in freer supply. With regard to export, there is not much change in the position here and the shortage of alkalis is indicated by the number of enquiries received.

Obituary

MR. ROBERT FERRIER MCKAY, manager of Dunlop's inventions and patents department since 1942 until he resigned last year, has died at the age of 67. He joined Dunlop in 1926 as engineer in the department formed for the development of the new technique of electrically depositing natural rubber latex by the Anode process. Mr. McKay was the author of 'The Theory of Machines' first published in 1914, and 'The Principles of Machine Design'. He was a lecturer in Engineering at the City and Guilds College, an examiner for B.Sc. (Eng.) London and Benares Universities, and an examiner for Associateship examination of the Institute of Civil Engineering for many years. He was an M.Sc., an A.M.I.C.E. (Bayliss Prizeman) and an M.I.Mech.E.

DR. JAMES FREDERICK SPENCER, M.A., Ph.D., D.Sc., F.R.I.C., of Eshe Road North, Great Crosby, Lancs., Professor Emeritus of Chemistry in the University of London, left £5,068, net £4,911.

Marchon



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Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

AFKAPS, LTD., Maidstone, chemists. (M., 7/7/51). 27 April, mortgage, to Lloyds Bank, Ltd., securing all moneys due or to become due to the Bank; charged on 105 and 105a Tonbridge Road, Maidstone. *£3,800. 21 April, 1950.

E. C. LONGMATE, LTD., Terrington St. John, chemists. (M., 7/7/51). 24 April, three charges, to Barclays Bank, Ltd., each securing all moneys due or to become due to the Bank; respectively charged on land and warehouse; land; and Fir Tree House, all Terrington St. John. *£6,000. 23 March, 1950.

INDUSTRIAL CHEMICALS, LTD., London, W.C. (M., 7/7/51). 27 April, £1,000 debentures, part of a series already registered. *£5,000 debentures. 17 October, 1950.

S. STONIER, LTD., Congleton, chemical manufacturers. (M., 7/7/51). 23 April, two charges to Barclays Bank, Ltd., each securing all moneys due or to become due to the Bank; respectively charged on land with two houses thereon at Crown Bank, Talke and land with mill, offices and premises known as The Mill, Holmes Chapel Road, Congelton. *Nil. 10 July, 1950.

Satisfaction

BRITISH GLUES & CHEMICALS, LTD., Welwyn Garden City. (M.S., 7/7/51). Satisfaction 28 April, of debenture registered 7 January, 1948.

New Registrations

Park (Swansea) Ltd.

Private company. (496,975). Registered June 28. Capital £1,000 in £1 shares. Objects: To carry on business of manufacturers, importers and exporters of and wholesale and retail dealers in proprietary medicines, emulsions, drugs, chemicals, chemical products, dyestuffs, colouring materials, etc. The directors are: Abraham G. Park, Mrs. Florence V. Park and Cecil P. Thomas, all of 16 Ysgol Street, St. Thomas, Swansea. Secretary: Florence V. Park. Solicitors: W. G. Christians & Sons, Swansea. Registered office: 16 Ysgol Street, St. Thomas, Swansea.

Increases of Capital

The following increases of capital have been announced:—WM. C. HOLLAND (DYESTUFFS), LTD., from £1,000 to £5,000; WESTWICK DISTRIBUTORS, LTD., from £2,500 to £15,000; NOSO PRODUCTS, LTD., from £5,000 to £10,000; J. C. GILBERT, LTD., increased by £10,000, in £1 ordinary shares, beyond the registered capital of £15,000.

Change of Name

The following change of name has been announced:—DONALD SHARPE, LTD., to BROCKHAM FOOD LABORATORIES, LTD.

Next Week's Events

MONDAY 9 JULY

Society of Chemical Industry

London: Geological and Science Museum, 8.0 p.m. Reception to delegates by the London Section.

TUESDAY 10 JULY

Society of Chemical Industry

London: Royal College of Science, South Kensington, 10.0 a.m. 70th annual general meeting. Presidential address.

WEDNESDAY 11 JULY

British Ceramic Society

Manchester: Midland Hotel, 10.0 a.m. General meeting. John Fox: 'Power Plant for Heavy Clay Industries'; F. Catchpole: 'The Attack of Kiln Flues by Sulphur-laden Gases'; I. M. D. Halliday: 'Gas Flow Kilns.'

Society of Chemical Industry

London: Royal Institution, Albemarle Street, W.1, 10.0 a.m. Presentation of the Society's Medal to Professor E. C. Dodds. 11.30 a.m. Opening of series of lectures 'Water in Industry.'

SATURDAY 14 JULY

International Welding Congress

London and Oxford (until 21 July).

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MALE LABORATORY ASSISTANTS required by old established firm of Chemical Manufacturers, with view to training as shift chemists. Commencing salary not less than £250 p.a. plus additional pay when working shifts. Full particulars to Box C.A. 3024, THE CHEMICAL AGE, 154 Fleet Street, London, E.C.4.

MINISTRY OF SUPPLY: PRINCIPAL SCIENTIFIC OFFICER OR SENIOR SCIENTIFIC OFFICER. The Civil Service Commissioners invite applications from **CHEMISTS** for a permanent appointment at the Atomic Energy Research Establishment, Harwell, nr. Didcot, Berks, for work on the electro-magnetic method of separation of stable isotopes. The duties of the post includes:

(*a*) Supervision of junior staff in the preparation of material for separation;
(*b*) The establishment of efficient methods of processing separated isotopes to produce them in forms satisfactory for use.
(*c*) Acting as deputy to the project leader with particular responsibilities for the promotion of the use of stable isotopes in physical and radio chemistry.

Candidates must have been born on or before August 1st, 1920, and must possess a 1st or 2nd class honours degree in Chemistry or equivalent qualification and have had considerable relevant experience. The electromagnetic method of separation is applicable to all polyisotopic elements so that the qualification required for (*a*) and (*b*) above is a wide knowledge of analytical inorganic chemistry.

The Commissioners may, at their discretion, admit a candidate with high professional attainments notwithstanding that he or she may not possess the above qualifications.

Salary scale Principal Scientific Officer (men) £960-£1,295, (women) £840-£1,140, Senior Scientific Officer (men) £720-£910, (women) £595-£810. Post carries benefits under Federated Superannuation System for Universities. Good housing prospects for selected candidate if married.

Further particulars and application forms from **The Secretary, Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, W.1 quoting No. S.4045/51.**

Completed applications must be returned by 8th August, 1951.

Candidates born between 2nd August, 1920, and 1st August, 1925, (inclusive) may be considered for appointment as Senior Scientific Officer but must apply through the Open Competition under Normal Regulations already announced (No. 3399).
12038/120/EH.

NORTH WESTERN GAS BOARD
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APPLICATIONS are invited for the position of **Deputy Chief Chemist** in the Liverpool Group.

Applicants should hold a Science Degree or equivalent qualification and should have had extensive experience of the scientific aspect of Gas Manufacture and Fuel Chemistry.

The salary will be £900 per annum, and the successful applicant may be required to pass a medical examination and subscribe to such superannuation scheme as the Board may adopt.

Application should be made by letter to the **Chief Personnel Officer, North Western Gas Board (Liverpool Group), Radiant House, Bold Street, Liverpool, 1.,** and should be delivered within fourteen days of the publication of this advertisement.

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2 **ELECTROSTATIC PRECIPITATION PLANTS** by Siemens Lurgi Cottrell, each with twin insulated collecting chambers containing Electrodes and Shaking gear. Chamber dimens. 62 ft. 6 in. high overall by 11 ft. 9 in. by 10 ft. Complete, with Fan, Cyclone and Dust Collector, and 20-kVA. Transformer.

JAR & BOTTLE CAPPER by Gravill. Cap. approx. 36 per min. with adjustment for various sizes. Motorized 220/240/1/50, through reduction gear. Unit mounted on C.I. stand with castor wheels.

BOTTLE RINSING M/C by Thomas & Hill. Chain conveyor type, 12 ft. centres, double row bottle fixtures 132 head. Rotary jet rinsing. Cap. 150 dozen half or pint bottles per hour. Motorized 400/3/50.

LABELLING M/C by Rawsons, for pint or 16 oz. size or flat or square. Cap. 24-30 per min. Numbering device. Motorized 400/3/50. Unit mounted on rubber tyred wheels.

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Carton **FILLING, PACKING, WRAPPING & LABELLING MACHINE** by Societe Industrielle Suisse, adjustable for cartons from 73 mm. sq. by 38 mm. to 65.6 mm. sq. by 38 mm. Motorized 400/3/50. Complete with label attachments and heat sealing device. Conveyor feed approx. 55 per min.

Two 72 in. **HYDRO EXTRACTORS** by Thomas Broadbent, 72 in. galv'd basket, 20 in. deep, ¼ in. perfs. Motorized 400/3/50.

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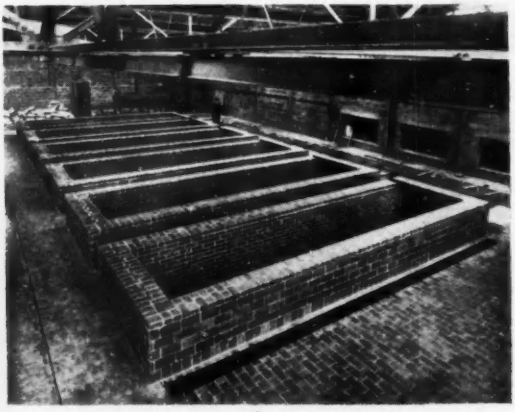

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